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(54) Title: FOOTWEAR SOLE AND ARCH STRAPPING SYSTEM		
(57) Abstract		
<p>A strapping system for footwear comprises a strap (1) that has a first end (3) connected to a first side of a heel portion (12) of footwear, passes over the instep of a foot, through a channel (31) extending through the midfoot of the footwear sole and back over the foot instep to thereby forming an X shape over the wearer's foot. The strap (1) has a second end (11) which may be adjustably connected to the second side of a heel portion (12) of a sole. The channel (31) is resilient and rigid so as to allow the strap freedom of movement during use; thereby achieving a dynamic and self adjusting strap fit. A footwear sole comprises relatively soft forefoot and heel portions with a more rigid shank portion therebetween to provide the sole with stiffness and torsional rigidity.</p>		

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FOOTWEAR SOLE AND ARCH STRAPPING SYSTEMBACKGROUND1. Field of the Invention

The present invention relates to footwear. In particular, the present invention is related to strapping systems for securely affixing footwear to a user's foot, and to shanks for providing rigidity and support to shoe soles.

2. Background of the Invention

There is a wide variety of prior art showing strapping configurations for footwear. Generally, the purpose of such strapping may be summarized as securing the footwear to a user's foot and is often used in connection with sandals.

Examples of prior art showing sandal or footwear strapping arrangements include U.S. Patents Nos. 4,200,997 and 4,446,633 to Scheinhaus, U.S. Pat. No. 4,679,334 to McBride, U.S. Pat. No. 3,327,410 to Park, U.S. Pat. No. 4,793,075 to Thatcher, U.S. Patent No. 4,817,302 to Saltsman, U.S. Patent No. 4,300,294 Riecken, U.S. Patent No. 2,788,591 to Gibson, U.S. Patent No. 2,126,094 to Daniels, and U.S. Patent No. 2,862,311 to Ellis. Each of these patents disclose strapping configurations which generally engage the ankle, heel, instep, toes, arch, or some combination thereof to secure the footwear to the user's foot. None of these prior art disclosures, however, nor any other existing strapping configurations have been entirely

satisfactory in securing footwear to the foot while maintaining a comfortable, durable, and convenient configuration. This problem is particularly acute for sandals used in sports or other vigorous activities. As sandals have become more frequently worn in these active endeavors, demands on strapping configurations have grown. No known existing sandal strapping configuration allows for the natural adjustments of the foot and ankle during activity; such adjustments would enhance user comfort and ease of use.

One particular problem relates to ankle or instep straps. As the angle between the foot and the ankle changes during normal walking or running, the foot's main tendon that travels down the front of the leg and across the instep of the foot is alternately tightened and loosened. This causes the overall circumference of the ankle and instep to increase and decrease. Any strapping that wraps the ankle must allow

torsional forces developed during wearing of footwear, especially those forces caused by straps that pass through the sole.

Numerous unresolved needs therefore exist relating to footwear. A long felt need exists for a footwear strapping configuration that accommodates the foot's wide

5 range of movement during sports or other vigorous activities. In addition, a need exists for strapping that is capable of dynamically adjusting itself as required during such use. Further, unresolved needs exist for an integral, stiff and rigid shank portion to provide torsional rigidity and stiffness to an otherwise relatively soft and cushioned footwear forefoot and heel portions.

10

SUMMARY OF THE INVENTION

A first embodiment of the present invention comprises a unique strapping configuration for footwear that provides for dynamic fit adjustment while securely and comfortably affixing a sole to a wearer's foot. The strapping generally includes an adjustable X configuration strap which is attached in some manner to a heel portion of the footwear, crosses over the wearer's instep, and passes through a transverse channel in the midsole of the footwear under the wearer's arch. The present invention further comprises footwear incorporating the unique strapping configuration that securely fastens the footwear to the user's foot, even during sports or other vigorous activities.

15

The adjustable X configuration instep strap generally has a first end secured to a first side of a heel portion of the footwear, crosses forwardly and transversely over the wearer's instep, passes through a channel in the sole of the footwear at the midfoot,

the longitudinal center of the sole, extends rearwardly and transversely back across the wearer's instep (thereby forming an X over the instep), and is adjustably and

20

releasably secured to the second side of the heel portion of the footwear. The channel

may be angled downwardly from rear to front in the longitudinal direction, parallel to the downward slope of the wearer's instep, so that the strap will lie flat on the

wearer's instep and thereby more evenly carry forces that develop between the foot and the sole during sports or other vigorous activities.

25

The X configuration instep strap acts to secure the wearer's foot to the footwear sole. The strap preferably passes under the wearer's arch through the midfoot

transverse channel described above for passing a strap. In addition, the sole of the invention may be particularly well suited for, but is not limited to, use in sandals.

In accordance with various aspects of the present invention, the sole may comprise a molded unit of two or more different densities of thermoplastic or thermosetting polymer compounds. One compound may be of suitably low density and hardness to provide flexibility and cushion. Near the midfoot region of the sole, underlying the user's arch, is a shank portion comprising a denser, harder, stiffer compound. The presence of the higher density, stiffer shank tends to insure that the arch of the foot will have improved support. In addition, the relatively stiff shank is desirable to lend structure and support to the sole at the midfoot region where the outsole does not touch the ground, to provide a desirable overall stiffness to the sole during walking, and to provide torsional rigidity. The structural effect of the shank may be easily controlled by varying the hardness of the shank as desired.

Before explaining the several embodiments of the disclosure in detail, it is to be understood that the disclosure is not limited in its application to the details of the construction and the arrangements set forth in the following description or illustrated in the drawings. The present invention is capable of other embodiments and of being practiced and carried out in various ways, as will be appreciated by those skilled in the art. Also, it is to be understood that the phraseology and terminology employed herein are for description and not limitation.

The advantages of the present invention will become more fully apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a perspective view of one embodiment of a strapping system of the present invention;

FIG. 2 is a detail of one embodiment of a fastener for use in connection with of the strapping system of the present invention;

FIG. 3 is a detailed medial side view of the midfoot channel useful in connection with the strapping system of the present invention;

configurations or heel portions may be used. For example, the heel strap system may comprise a unitary structure formed of webbing or other material, or may comprise a plurality of interconnected straps. These and other modifications are within the scope of the present invention.

5 Moreover, it should be appreciated that ends 3 and 11 may be attached to heel portion 12 at any desirable location, for example at any point along the path traversed by strap 16.

One attachment device useful for attaching at least a portion of strap 1 to heel portion 12 is illustrated in Fig. 2, comprising mating hook and loop fasteners. In 10 accordance with this embodiment, strap 1 passes through a pivot loop 21 attached to the heel post 15 of the footwear. A section of mating hooks 23 are preferably located on the bottom of strap 1 near strap second end 11. A corresponding section of mating loops 25 are located on the top side of strap 1. Strap 1 may thereby be adjustably and removably attached to itself by pulling it through pivot loop 21 to a desired tightness 15 and releasably fixing section of hooks 23 onto section of loops 25. Other attaching devices may comprise mating female - male connectors, buckles, friction buckles, snaps, buttons, shoe laces, or other fasteners now known or hereafter devised in the art. Moreover, strap 1 may be adjustably attached at end 3 to heel portion 12, or alternatively not be adjustably attached to either end 11 or 3.

20 Preferably, strap 1, as previously noted, passes through channel 31. In accordance with various alternative embodiments, however, strap 1 may be attached to or within the sole 8.

With reference now to Fig. 4, channel 31 preferably extends across the width of the midfoot region of the sole and is substantially perpendicular to a longitudinal axis 25 of the sole. Angular orientations, for example, from front to back or vice versa, may also be utilized.

In accordance with various aspects of the present invention sole midfoot region 7 may include a shank 7. Shank 7 may comprise any resilient, stiff material to help prevent channel 31 from collapsing and pinch strap 1 when force is applied downward 30 on the shank 7 during use. The stiffness and resiliency of shank 7 also tends to impart advantageous strength and torsional rigidity to the sole. Shank 7 may be manufactured separate from the softer and more pliable sole and attached thereto with

weaves may optionally comprise reflective material, thereby providing 360° reflectivity for enhanced user safety.

While the strap assembly set forth in Fig. 1 and variously referred to herein as a "strap assembly" may be used on a variety of footwear products, a preferred

5 embodiment in accordance with the present invention comprises a sandal 40, such as is shown in Fig. 5. Sandal 40 preferably includes a sole 51 and a variety of straps including a version of the strap assembly hereof connected thereto. Preferably, a strap 41 has a first end 43 attached to a heel post 45. Strap 41 passes over a foot instep and into a channel 47. Channel 47 preferably extends transversely through sole 10 51. After exiting channel 47, strap 41 passes back over the foot instep, through a midfoot loop 53. A fastener 55 for adjustable fastening of strap 41 to heel post 57 cooperates to secure strap 41 to loop 53. Strap 41 thereby forms an X-shape over the wearer's instep. Fastener 55 may comprise a buckle with lever as illustrated, or other means as are known in the art, including, for example, hook and loop fasteners, 15 male-female connectors, buckles, buttons, snaps, shoe laces, and the like.

Sole midfoot region 49 may be fabricated from a resilient and relatively stiff material to provide desirable torsional rigidity to the softer and more pliable sole 51. In addition, the stiff and relatively rigid construction of midfoot region, or shank 49, provides support to the arch region of a wearer's foot. Advantages related to torsional 20 25 rigidity and arch region support will be discussed in greater detail below in association with additional embodiments of the invention.

Because preferred sole midfoot region 49 may be comprised of a resilient plastic material while sole 51 may be comprised of a softer, more pliable material, sole midfoot region 49 is preferably manufactured separate from sole 51 and then affixed thereto using adhesives or the like. Midfoot region 49 need not necessarily be prepared separately from sole 51 and attached thereto; it may also be integral with sole 51. Sole 51 is constructed as generally known in the art, and may, for example, be comprised of a relatively tough and wear resistant outsole, and a softer and more cushioned midsole. A soft insole or footbed for contact with the wearer's foot may be adhered to the upper surface of the sole. As used herein, the term "sole" refers to the structural sole of the footwear, and includes a unitary sole, an outsole and/or midsole,

of a foot and includes a forefoot portion 116, a heel portion 118, a medial side 120 and a lateral side 121. Sole piece 112 may be comprised of a wide variety of thermoplastic and thermosetting polymer compounds. Ethylene vinyl acetate ("EVA") foam is preferred, but other compounds may be used. The density and 5 hardness of sole piece 112 may be set as desired, with a relatively soft, cushioned consistency desirable for foot comfort. Hardness ranges for sole piece 112 will range between about 30 and about 60 Shore C hardness, with a preferred hardness of about 55 +/- 2 Shore C. Shank 114 resides in the midfoot region of sole 110, underlying the user's arch and bridging the heel and forefoot region.

10 Shank 114 preferably extends all the way through the sole 110 in a vertical direction, as best seen in Fig. 7. In addition, shank 114 is not located only in either the medial or lateral portion of sole 110, but preferably extends into both portions for optimum torsional rigidity. An embodiment of the shank of the invention may extend substantially across the transverse width of the footwear sole, as generally described 15 hereinabove with reference to previous footwear embodiments of the invention. The specific configuration of the shank is not critical, but preferably Shank 114 is sized to bridge between the heel and forefoot regions of the sole. Shank 114 may also be comprised of a suitable thermoplastic or thermosetting polymer compound, with EVA foam preferred. Shank 114 may optionally comprise a channel (like channel 31 20 shown in Fig. 1) for passing a strap as described above with reference to previously illustrated embodiments of the invention. The composition of shank 114 is denser, and hence stiffer and harder, than sole piece 112. In accordance with certain embodiments of the present invention, shank 114 preferably has a hardness in the range of between about 55 and about 85 Shore C hardness, with a preferred hardness 25 of about 80 +/- 2 Shore C. Preferably a differential of about 20 to about 30 Shore C hardness exists between sole piece 112 and shank 114.

30 A preferred method of making the integral sole piece 112 and shank 114 of the invention comprises the steps of cutting out a portion of sole piece 112 corresponding to the shape of shank 114, cutting out a shank piece 114 from suitable hardness material, and hot compression molding shank 114 into sole piece 112. Chemical cross-linking bonds are thereby formed between shank 114 and sole piece 112,

exemplary embodiment of top sole 172 has a shape and thickness that correspond to the recess 182 in the midsole 170, so that a substantially flush surface results upon attachment of the top sole to the midsole. Top sole 172 is preferably comprised of EVA foam with a hardness of about 20 to about 40 Shore C durometer.

5 Top sole 172 may have an arcuate indentation 184 at the medial midfoot to match raised portion 178 of shank 152 thereby enabling exposure of portion 178 when top sole 172 is in place. Alternatively, top sole 172 may completely cover shank 152 including raised portion 178. In either case, however, preferably a substantially flush outer surface is obtained. For example, outsole 174 may include a raised ridge 186 about its outer perimeter that will wrap around outer, lower edges 187 of the midsole. A preferred outsole raised edge 186 has opposing front side portions 188, opposing rear side portions 190, front end 192, and back end 194 that are raised higher than the remainder of raised edge 186. These regions correspond to areas of increased wear, thereby making durable outsole 174 desirable.

10 15 Outsole 174 preferably includes a bridge portion 196 which rests in the shank groove 164 of the midsole. Placement of bridge portion 196 in groove 164 helps to stabilize outsole 174 from lateral movement relative to the midsole. Outsole 174 may be comprised of any resilient, rubber like material, or polyurethane, and is preferably attached to the bottom of integral sole 170.

20 25 The advantages of the disclosed invention are thus attained in an economical, practical, and facile manner. While preferred embodiments and example configurations have been shown and described, it is to be understood that various further modifications and additional configurations will be apparent to those skilled in the art. It is intended that the specific embodiments and configurations herein disclosed are illustrative of the preferred and best modes for practicing the invention, and should not be interpreted as limitations on the scope of the invention as defined by the appended claims.

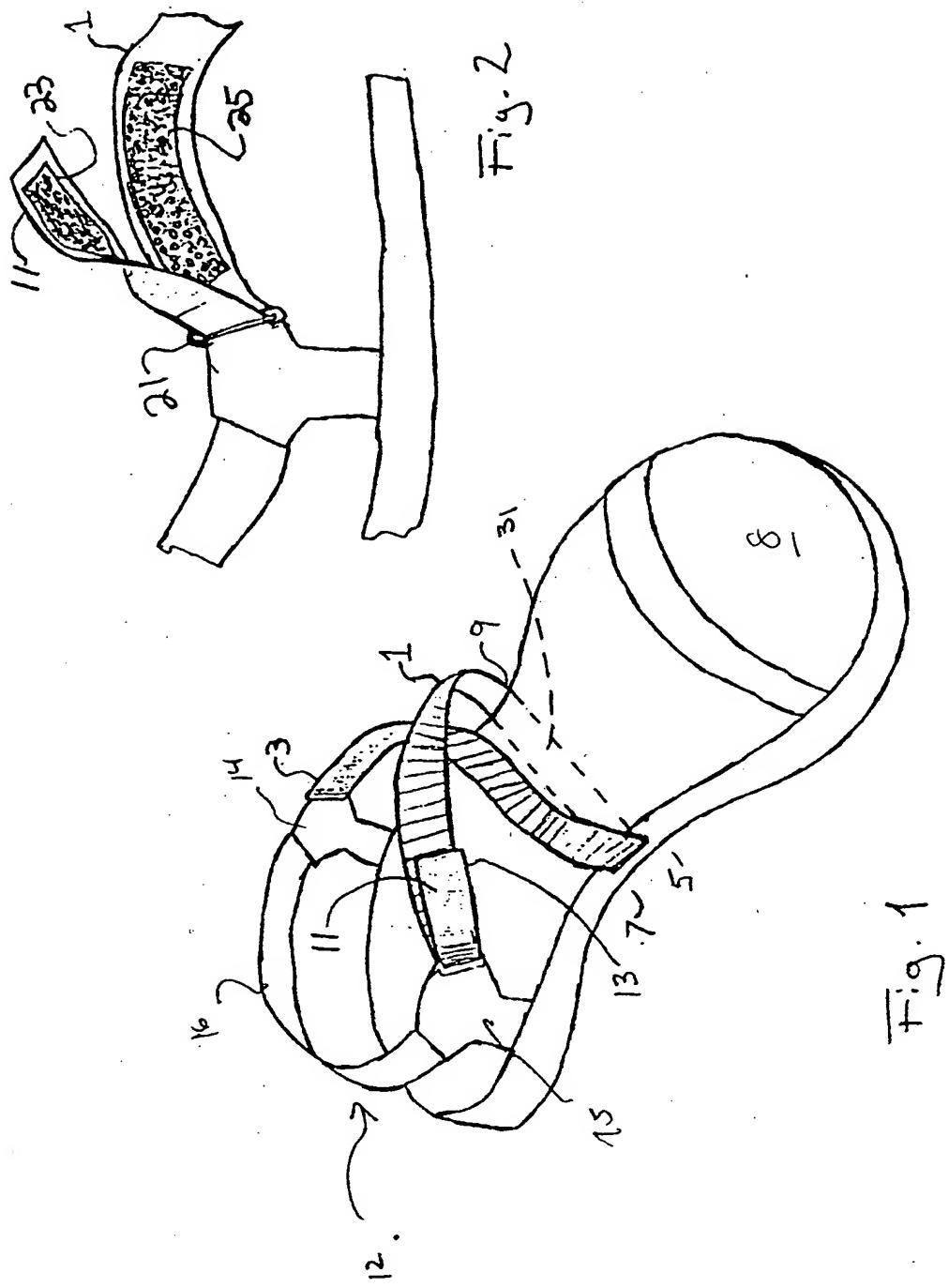
1 4. An article of footwear, as in claim 3, wherein said channel is angled
2 downwardly from rear to front in a longitudinal direction;

1 5. An article of footwear as in claim 4 further comprising a heel portion strap
2 assembly, a forefoot strap assembly and a lateral strap extending therebetween.

1 6. A footwear product to be worn by a user on the user's foot, comprising:
2 a) a sole;
3 b) a transverse passageway extending through said sole; and
4 c) a strap system configured to secure the footwear product to the user's
5 foot including:
6 a heel portion,
7 an X-strap assembly coupled to said heel portion, wherein said X-strap
8 assembly includes a continuous strap having a first portion extending transversely
9 across the user's instep from a first side of the footwear to a second side, a second
10 portion extending through said transverse passageway, and a third portion extending
11 transversely across the user's instep from said second side to said first side of said
12 footwear, said first and said third portions of said X-strap assembly forming an
13 X-configuration over the user's instep, and
14 an adjustable fastener for adjusting the length of said X-strap assembly.

1 7. A sole having a forefoot, heel, and midfoot therebetween, comprising:
2 a) a foot shaped sole piece of a polymer compound of selected hardness;
3 and
4 b) a shank within the midfoot of said sole piece and bridging between
5 the forefoot and heel, said shank having a higher hardness than said sole piece, and
6 said shank being integrally fused to said sole piece.

8. A sole as in claim 7, wherein said sole is a sandal sole.



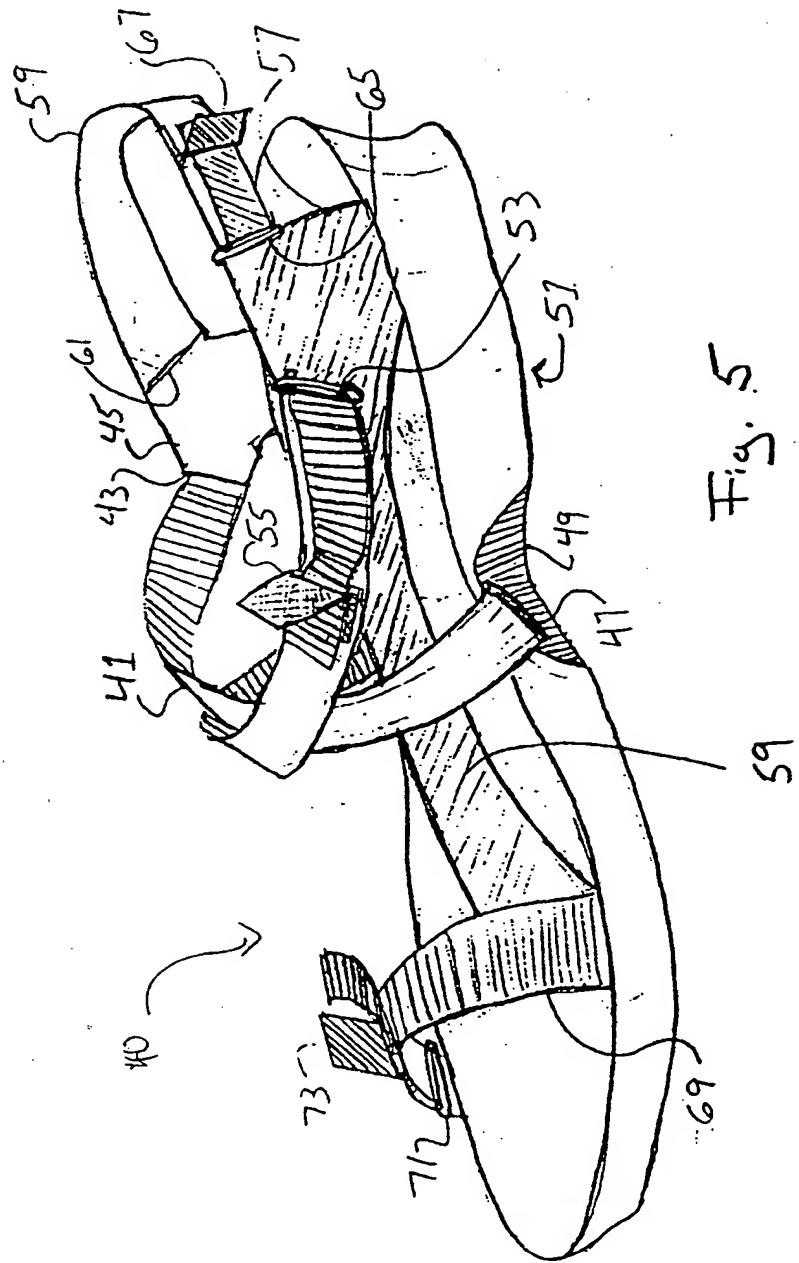


Fig. 5

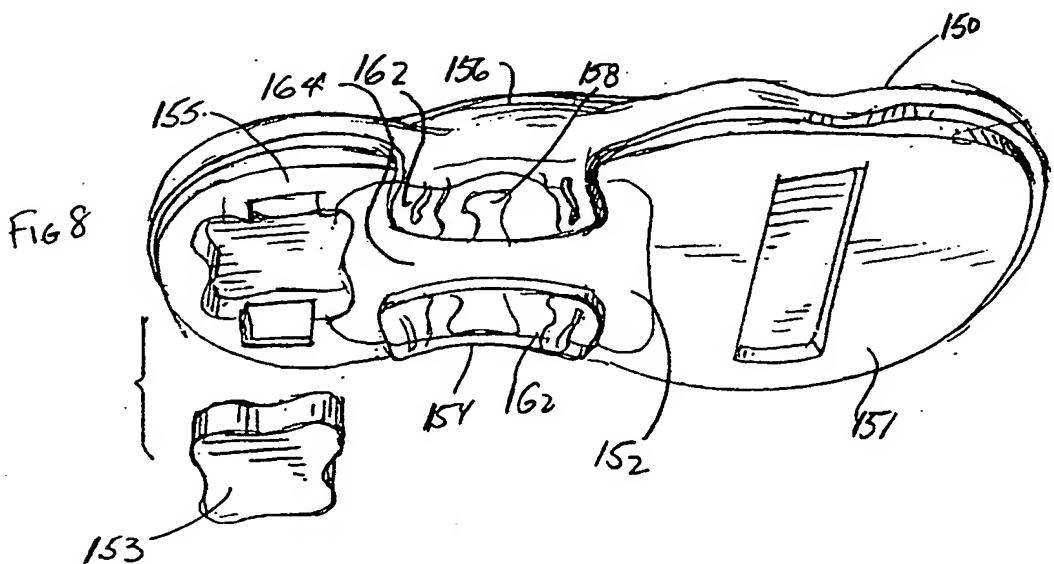
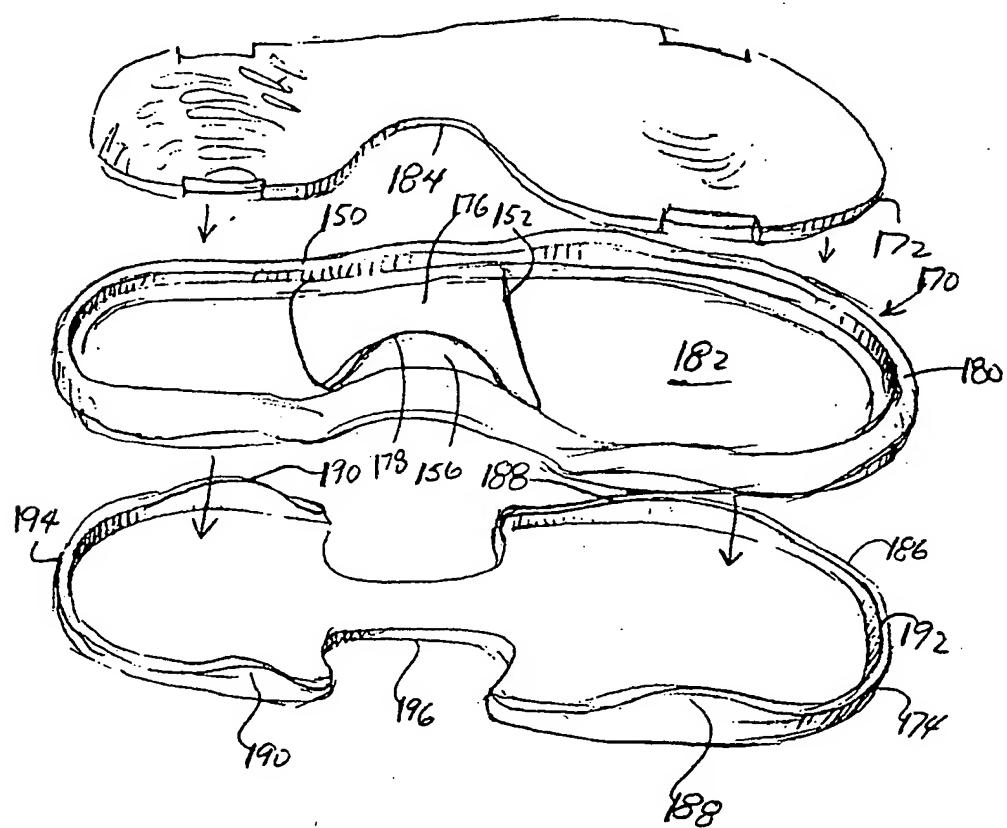


FIG. 9



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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/20297

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 533 278 A (STEIN MICHAEL) 9 July 1996 (1996-07-09) the whole document ---	5
A	EP 0 740 908 A (ROSSIGNOL SA) 6 November 1996 (1996-11-06) column 10, line 42 -column 11, line 40; figures 1,15 ---	7,10
A	US 4 314 412 A (ANDERSON BLAIR V ET AL) 9 February 1982 (1982-02-09) column 4 ---	1,2,6,7, 14
A	US 4 398 357 A (BATRA VIJAY K) 16 August 1983 (1983-08-16) the whole document ----	9
A	US 3 747 239 A (GREEN R) 24 July 1973 (1973-07-24) the whole document -----	1,2,4,6

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6

2. Claims: 7-15

**CORRECTED
VERSION***

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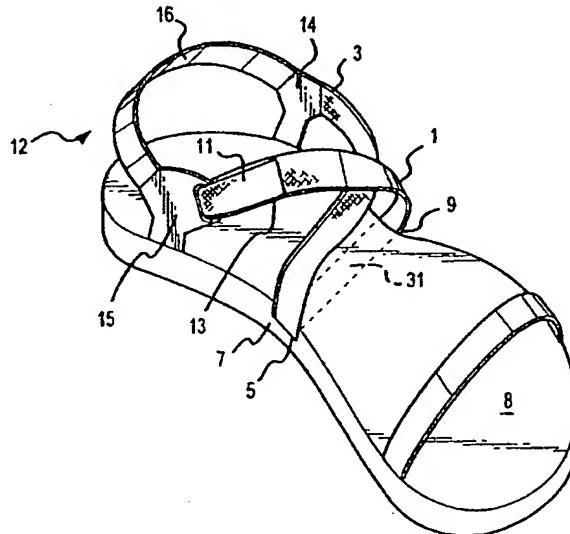
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(54) Title: FOOTWEAR SOLE AND ARCH STRAPPING SYSTEM



(57) Abstract

A strapping system for footwear comprises a strap (1) that has a first end (3) connected to a first side of a heel portion (12) of footwear, passes over the instep of a foot, through a channel (31) extending through the midfoot of the footwear sole and back over the foot instep to thereby forming an X shape over the wearer's foot. The strap (1) has a second end (11) which may be adjustably connected to the second side of a heel portion (12) of a sole. The channel (31) is resilient and rigid so as to allow the strap freedom of movement during use: thereby achieving a dynamic and self adjusting strap fit. A footwear sole comprises relatively soft forefoot and heel portions with a more rigid shank portion therebetween to provide the sole with stiffness and torsional rigidity.

FOOTWEAR SOLE AND ARCH STRAPPING SYSTEMBACKGROUND1. Field of the Invention

The present invention relates to footwear. In particular, the present invention is related to strapping systems for securely affixing footwear to a user's foot, and to shanks for providing rigidity and support to shoe soles.

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One particular problem relates to ankle or instep straps. As the angle between the foot and the ankle changes during normal walking or running, the foot's main tendon that travels down the front of the leg and across the instep of the foot is alternately tightened and loosened. This causes the overall circumference of the ankle and instep to increase and decrease. Any strapping that wraps the ankle must allow

torsional forces developed during wearing of footwear, especially those forces caused by straps that pass through the sole.

Numerous unresolved needs therefore exist relating to footwear. A long felt need exists for a footwear strapping configuration that accommodates the foot's wide range of movement during sports or other vigorous activities. In addition, a need exists for strapping that is capable of dynamically adjusting itself as required during such use. Further, unresolved needs exist for an integral, stiff and rigid shank portion to provide torsional rigidity and stiffness to an otherwise relatively soft and cushioned footwear forefoot and heel portions.

10

SUMMARY OF THE INVENTION

A first embodiment of the present invention comprises a unique strapping configuration for footwear that provides for dynamic fit adjustment while securely and comfortably affixing a sole to a wearer's foot. The strapping generally includes an adjustable X configuration strap which is attached in some manner to a heel portion of the footwear, crosses over the wearer's instep, and passes through a transverse channel in the midsole of the footwear under the wearer's arch. The present invention further comprises footwear incorporating the unique strapping configuration that securely fastens the footwear to the user's foot, even during sports or other vigorous activities.

15

The adjustable X configuration instep strap generally has a first end secured to a first side of a heel portion of the footwear, crosses forwardly and transversely over the wearer's instep, passes through a channel in the sole of the footwear at the midfoot,

the longitudinal center of the sole, extends rearwardly and transversely back across the wearer's instep (thereby forming an X over the instep), and is adjustably and

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releasably secured to the second side of the heel portion of the footwear. The channel may be angled downwardly from rear to front in the longitudinal direction, parallel to

the downward slope of the wearer's instep, so that the strap will lie flat on the wearer's instep and thereby more evenly carry forces that develop between the foot

and the sole during sports or other vigorous activities.

25

The X configuration instep strap acts to secure the wearer's foot to the footwear sole. The strap preferably passes under the wearer's arch through the midfoot

transverse channel described above for passing a strap. In addition, the sole of the invention may be particularly well suited for, but is not limited to, use in sandals.

In accordance with various aspects of the present invention, the sole may comprise a molded unit of two or more different densities of thermoplastic or thermosetting polymer compounds. One compound may be of suitably low density and hardness to provide flexibility and cushion. Near the midfoot region of the sole, underlying the user's arch, is a shank portion comprising a denser, harder, stiffer compound. The presence of the higher density, stiffer shank tends to insure that the arch of the foot will have improved support. In addition, the relatively stiff shank is desirable to lend structure and support to the sole at the midfoot region where the outsole does not touch the ground, to provide a desirable overall stiffness to the sole during walking, and to provide torsional rigidity. The structural effect of the shank may be easily controlled by varying the hardness of the shank as desired.

Before explaining the several embodiments of the disclosure in detail, it is to be understood that the disclosure is not limited in its application to the details of the construction and the arrangements set forth in the following description or illustrated in the drawings. The present invention is capable of other embodiments and of being practiced and carried out in various ways, as will be appreciated by those skilled in the art. Also, it is to be understood that the phraseology and terminology employed herein are for description and not limitation.

The advantages of the present invention will become more fully apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a perspective view of one embodiment of a strapping system of the present invention;

FIG. 2 is a detail of one embodiment of a fastener for use in connection with of the strapping system of the present invention;

FIG. 3 is a detailed medial side view of the midfoot channel useful in connection with the strapping system of the present invention;

configurations or heel portions may be used. For example, the heel strap system may comprise a unitary structure formed of webbing or other material, or may comprise a plurality of interconnected straps. These and other modifications are within the scope of the present invention.

5 Moreover, it should be appreciated that ends 3 and 11 may be attached to heel portion 12 at any desirable location, for example at any point along the path traversed by strap 16.

One attachment device useful for attaching at least a portion of strap 1 to heel portion 12 is illustrated in Fig. 2, comprising mating hook and loop fasteners. In 10 accordance with this embodiment, strap 1 passes through a pivot loop 21 attached to the heel post 15 of the footwear. A section of mating hooks 23 are preferably located on the bottom of strap 1 near strap second end 11. A corresponding section of mating loops 25 are located on the top side of strap 1. Strap 1 may thereby be adjustably and removably attached to itself by pulling it through pivot loop 21 to a desired tightness 15 and releasably fixing section of hooks 23 onto section of loops 25. Other attaching devices may comprise mating female - male connectors, buckles, friction buckles, snaps, buttons, shoe laces, or other fasteners now known or hereafter devised in the art. Moreover, strap 1 may be adjustably attached at end 3 to heel portion 12, or alternatively not be adjustably attached to either end 11 or 3.

20 Preferably, strap 1, as previously noted, passes through channel 31. In accordance with various alternative embodiments, however, strap 1 may be attached to or within the sole 8.

With reference now to Fig. 4, channel 31 preferably extends across the width of the midfoot region of the sole and is substantially perpendicular to a longitudinal axis 25 of the sole. Angular orientations, for example, from front to back or vice versa, may also be utilized.

In accordance with various aspects of the present invention sole midfoot region 7 may include a shank 7. Shank 7 may comprise any resilient, stiff material to help prevent channel 31 from collapsing and pinch strap 1 when force is applied downward 30 on the shank 7 during use. The stiffness and resiliency of shank 7 also tends to impart advantageous strength and torsional rigidity to the sole. Shank 7 may be manufactured separate from the softer and more pliable sole and attached thereto with

weaves may optionally comprise reflective material, thereby providing 360° reflectivity for enhanced user safety.

While the strap assembly set forth in Fig. 1 and variously referred to herein as a "strap assembly" may be used on a variety of footwear products, a preferred

5 embodiment in accordance with the present invention comprises a sandal 40, such as is shown in Fig. 5. Sandal 40 preferably includes a sole 51 and a variety of straps including a version of the strap assembly hereof connected thereto. Preferably, a strap 41 has a first end 43 attached to a heel post 45. Strap 41 passes over a foot instep and into a channel 47. Channel 47 preferably extends transversely through sole 10 51. After exiting channel 47, strap 41 passes back over the foot instep, through a midfoot loop 53. A fastener 55 for adjustable fastening of strap 41 to heel post 57 cooperates to secure strap 41 to loop 53. Strap 41 thereby forms an X-shape over the wearer's instep. Fastener 55 may comprise a buckle with lever as illustrated, or other means as are known in the art, including, for example, hook and loop fasteners, 15 male-female connectors, buckles, buttons, snaps, shoe laces, and the like.

Sole midfoot region 49 may be fabricated from a resilient and relatively stiff material to provide desirable torsional rigidity to the softer and more pliable sole 51. In addition, the stiff and relatively rigid construction of midfoot region, or shank 49, provides support to the arch region of a wearer's foot. Advantages related to torsional 20 20 rigidity and arch region support will be discussed in greater detail below in association with additional embodiments of the invention.

Because preferred sole midfoot region 49 may be comprised of a resilient plastic material while sole 51 may be comprised of a softer, more pliable material, sole midfoot region 49 is preferably manufactured separate from sole 51 and then affixed 25 thereto using adhesives or the like. Midfoot region 49 need not necessarily be prepared separately from sole 51 and attached thereto; it may also be integral with sole 51. Sole 51 is constructed as generally known in the art, and may, for example, be comprised of a relatively tough and wear resistant outsole, and a softer and more cushioned midsole. A soft insole or footbed for contact with the wearer's foot may be 30 adhered to the upper surface of the sole. As used herein, the term "sole" refers to the structural sole of the footwear, and includes a unitary sole, an outsole and/or midsole,

of a foot and includes a forefoot portion 116, a heel portion 118, a medial side 120 and a lateral side 121. Sole piece 112 may be comprised of a wide variety of thermoplastic and thermosetting polymer compounds. Ethylene vinyl acetate ("EVA") foam is preferred, but other compounds may be used. The density and

5 hardness of sole piece 112 may be set as desired, with a relatively soft, cushioned consistency desirable for foot comfort. Hardness ranges for sole piece 112 will range between about 30 and about 60 Shore C hardness, with a preferred hardness of about 55 +/- 2 Shore C. Shank 114 resides in the midfoot region of sole 110, underlying the user's arch and bridging the heel and forefoot region.

10 Shank 114 preferably extends all the way through the sole 110 in a vertical direction, as best seen in Fig. 7. In addition, shank 114 is not located only in either the medial or lateral portion of sole 110, but preferably extends into both portions for optimum torsional rigidity. An embodiment of the shank of the invention may extend substantially across the transverse width of the footwear sole, as generally described
15 hereinabove with reference to previous footwear embodiments of the invention. The specific configuration of the shank is not critical, but preferably Shank 114 is sized to bridge between the heel and forefoot regions of the sole. Shank 114 may also be comprised of a suitable thermoplastic or thermosetting polymer compound, with EVA foam preferred. Shank 114 may optionally comprise a channel (like channel 31
20 shown in Fig. 1) for passing a strap as described above with reference to previously illustrated embodiments of the invention. The composition of shank 114 is denser, and hence stiffer and harder, than sole piece 112. In accordance with certain
embodiments of the present invention, shank 114 preferably has a hardness in the
range of between about 55 and about 85 Shore C hardness, with a preferred hardness
25 of about 80 +/- 2 Shore C. Preferably a differential of about 20 to about 30 Shore C
hardness exists between sole piece 112 and shank 114.

A preferred method of making the integral sole piece 112 and shank 114 of the invention comprises the steps of cutting out a portion of sole piece 112 corresponding to the shape of shank 114, cutting out a shank piece 114 from suitable hardness
30 material, and hot compression molding shank 114 into sole piece 112. Chemical cross-linking bonds are thereby formed between shank 114 and sole piece 112,

exemplary embodiment of top sole 172 has a shape and thickness that correspond to the recess 182 in the midsole 170, so that a substantially flush surface results upon attachment of the top sole to the midsole. Top sole 172 is preferably comprised of EVA foam with a hardness of about 20 to about 40 Shore C durometer.

5 Top sole 172 may have an arcuate indentation 184 at the medial midfoot to match raised portion 178 of shank 152 thereby enabling exposure of portion 178 when top sole 172 is in place. Alternatively, top sole 172 may completely cover shank 152 including raised portion 178. In either case, however, preferably a substantially flush outer surface is obtained. For example, outsole 174 may include a raised ridge 186

10 about its outer perimeter that will wrap around outer, lower edges 187 of the midsole. A preferred outsole raised edge 186 has opposing front side portions 188, opposing rear side portions 190, front end 192, and back end 194 that are raised higher than the remainder of raised edge 186. These regions correspond to areas of increased wear, thereby making durable outsole 174 desirable.

15 Outsole 174 preferably includes a bridge portion 196 which rests in the shank groove 164 of the midsole. Placement of bridge portion 196 in groove 164 helps to stabilize outsole 174 from lateral movement relative to the midsole. Outsole 174 may be comprised of any resilient, rubber like material, or polyurethane, and is preferably attached to the bottom of integral sole 170.

20 The advantages of the disclosed invention are thus attained in an economical, practical, and facile manner. While preferred embodiments and example configurations have been shown and described, it is to be understood that various further modifications and additional configurations will be apparent to those skilled in the art. It is intended that the specific embodiments and configurations herein disclosed are illustrative of the preferred and best modes for practicing the invention, and should not be interpreted as limitations on the scope of the invention as defined by the appended claims.

25

1 4. An article of footwear, as in claim 3, wherein said channel is angled
2 downwardly from rear to front in a longitudinal direction;

1 5. An article of footwear as in claim 4 further comprising a heel portion strap
2 assembly, a forefoot strap assembly and a lateral strap extending therebetween.

1 6. A footwear product to be worn by a user on the user's foot, comprising:
2 a) a sole;
3 b) a transverse passageway extending through said sole; and
4 c) a strap system configured to secure the footwear product to the user's
5 foot including:
6 a heel portion,
7 an X-strap assembly coupled to said heel portion, wherein said X-strap
8 assembly includes a continuous strap having a first portion extending transversely
9 across the user's instep from a first side of the footwear to a second side, a second
10 portion extending through said transverse passageway, and a third portion extending
11 transversely across the user's instep from said second side to said first side of said
12 footwear, said first and said third portions of said X-strap assembly forming an
13 X-configuration over the user's instep, and
14 an adjustable fastener for adjusting the length of said X-strap assembly.

1 7. A sole having a forefoot, heel, and midfoot therebetween, comprising:
2 a) a foot shaped sole piece of a polymer compound of selected hardness;
3 and
4 b) a shank within the midfoot of said sole piece and bridging between
5 the forefoot and heel, said shank having a higher hardness than said sole piece, and
6 said shank being integrally fused to said sole piece.

8. A sole as in claim 7, wherein said sole is a sandal sole.

1/5

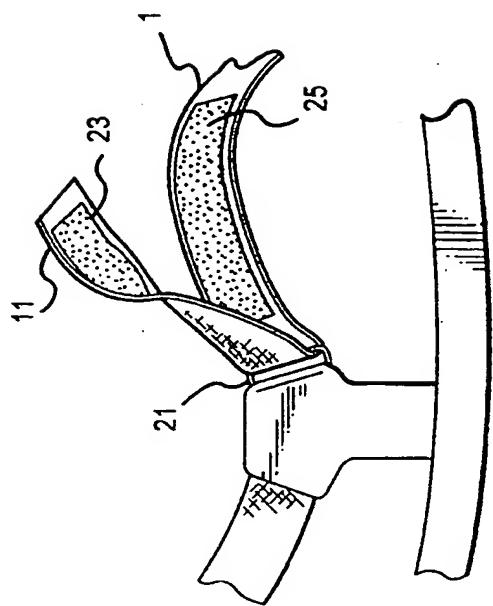


FIG. 2

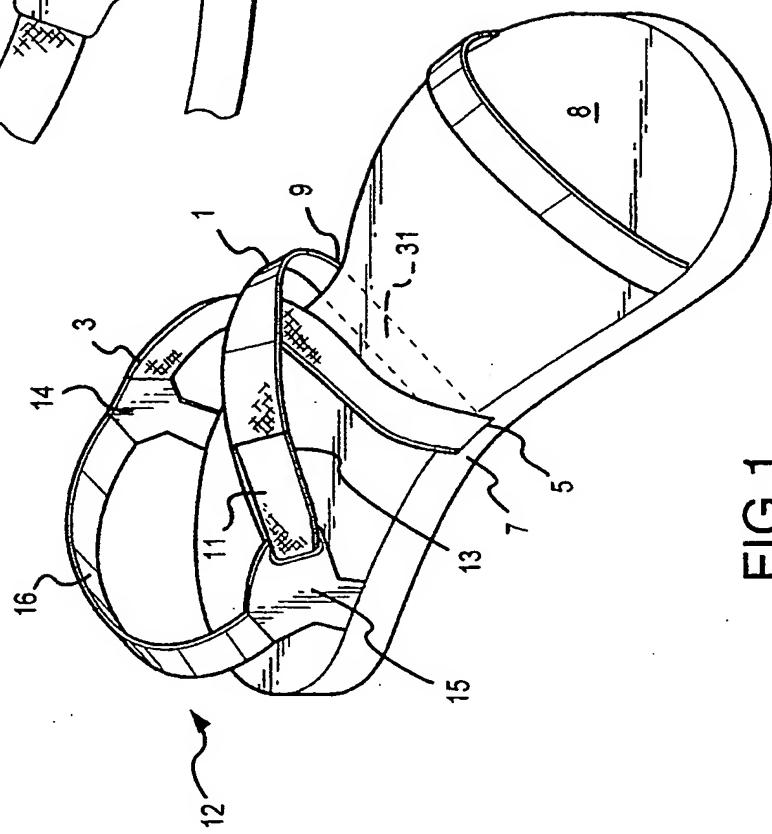


FIG. 1

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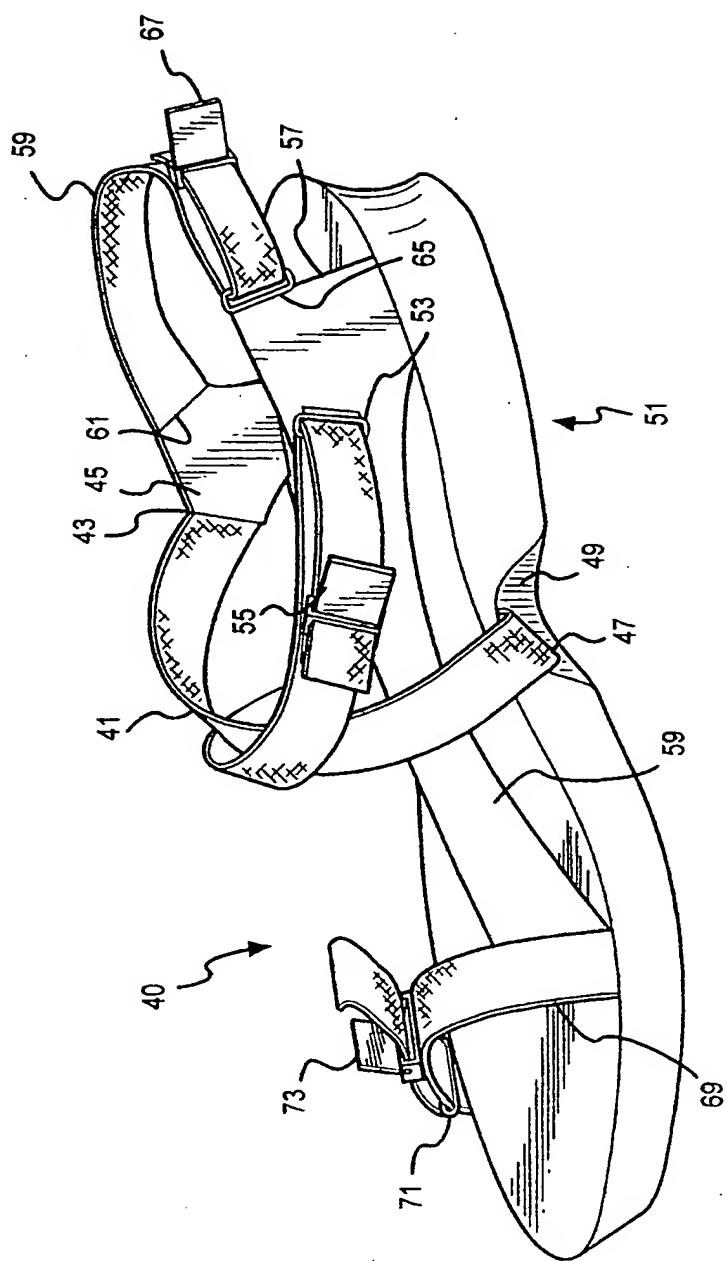
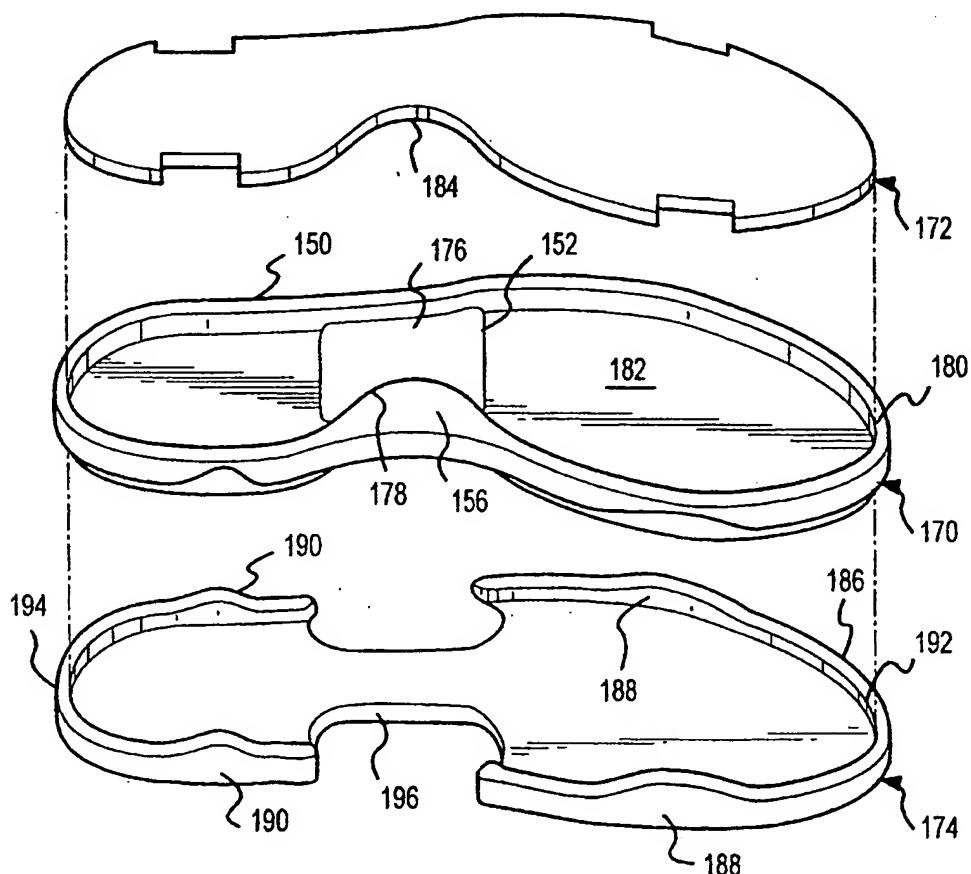
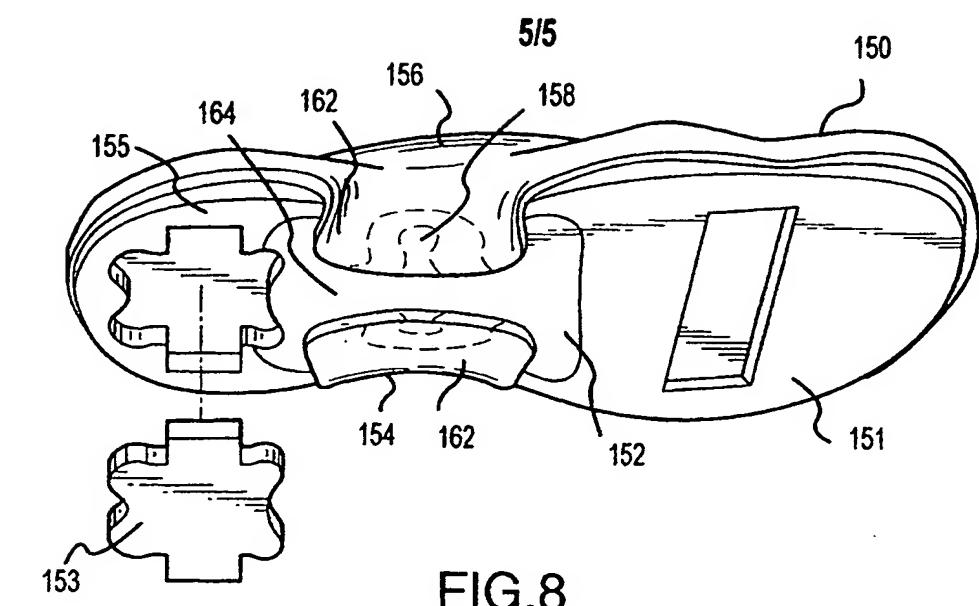


FIG.5



INTERNATIONAL SEARCH REPORT

Internat'l Application No
PCT/US 99/20297

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 533 278 A (STEIN MICHAEL) 9 July 1996 (1996-07-09) the whole document ---	5
A	EP 0 740 908 A (ROSSIGNOL SA) 6 November 1996 (1996-11-06) column 10, line 42 -column 11, line 40; figures 1,15 ---	7,10
A	US 4 314 412 A (ANDERSON BLAIR V ET AL) 9 February 1982 (1982-02-09) column 4 ---	1,2,6,7, 14
A	US 4 398 357 A (BATRA VIJAY K) 16 August 1983 (1983-08-16) the whole document ---	9
A	US 3 747 239 A (GREEN R) 24 July 1973 (1973-07-24) the whole document -----	1,2,4,6

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6

2. Claims: 7-15

DE1057913

Patent number: DE1057913
Publication date: 1959-05-21
Inventor: HAINTHALER HANS
Applicant: HANS HAINTHALER
Classification:
- **international:** A43B3/10; A43B3/12; A43B3/10; A43B3/12;
- **european:** A43B3/10B1; A43B3/12L
Application number: DE1957H029839 19570409
Priority number(s): DE1957H029839 19570409

[Report a data error here](#)

Abstract not available for DE1057913

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1057913

3

Fußes umschließende Verbreiterung aus weichem, geschmeidigem Material aufweist, welches sich im abgeklappten Zustand der Befestigungsmittel ebenfalls um die Stufe (3) im Fersenteil der Sohle legen läßt.

4. Pantoffel nach Anspruch 3, dadurch gekennzeichnet, daß das den Fersenbereich des Fersen-

4

riemens verbreiternde, die Fußferse umschließende Materialstück mit seinem unteren Rand an der Sohle (1) befestigt ist.

5

In Betracht gezogene Druckschriften:
Deutsche Patentschrift Nr. 626 331;
österreichische Patentschrift Nr. 70 626.

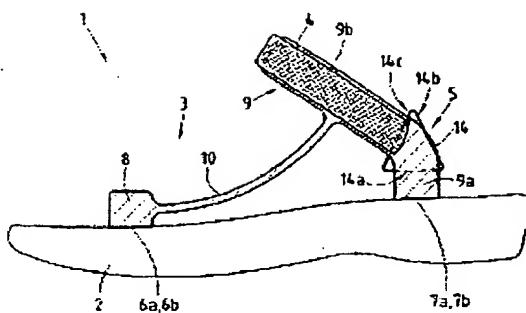
Hierzu 1 Blatt Zeichnungen

Sandal with back strap having two positions

Patent number: FR2774562
Publication date: 1999-08-13
Inventor: BENADDI STEPHANE
Applicant: DECATHLON SA (FR)
Classification:
- **international:** A43B3/12; A43B3/12; (IPC1-7): A43B3/12
- **european:** A43B3/12L
Application number: FR19980001859 19980211
Priority number(s): FR19980001859 19980211

[Report a data error here](#)**Abstract of FR2774562**

The sandal (1) has a sole to which a front strap (9) is fixed. A back strap (4) passes round the heel and each end is joined to the front strap by a ring (14) that has the shape of an isosceles triangle. It pivots on the ring between a back position and a position above the front strap.



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CHAUSSURE, NOTAMMENT DU TYPE SANDALE A LANIERE
ARRIERE PIVOTANTE

La présente invention concerne une chaussure comportant une semelle et un élément de recouvrement de l'avant du pied et une lanière arrière destinée à venir 5 s'appliquer sur le talon. Elle concerne plus particulièrement une chaussure de type sandale dans laquelle l'élément avant de recouvrement est constitué de lanières.

La sandale fait partie des chaussures de tenue décontractée, portées notamment sur les lieux de vacances, en particulier la plage et la montagne. Elle est constituée d'une semelle et d'un ensemble de lanières qui assurent le maintien 10 du pied sur la semelle. Parmi celles-ci une lanière est destinée à venir en appui sur le talon de l'utilisateur et assure ainsi le maintien de l'arrière du pied. Des systèmes de réglage permettent d'adapter la longueur des lanières en fonction de la taille du pied de l'usager.

On connaît, comme autre type de chaussure, la mule qui est composée 15 d'une semelle et d'un élément de recouvrement de la partie avant, qui laisse dégagé l'arrière du pied. Dans ce type de chaussure, le talon n'est pas maintenu.

Le but que s'est fixé le demandeur est de proposer une chaussure qui puisse être utilisée à la fois comme une sandale et comme une mule, au gré du souhait de l'utilisateur.

20 Bien sûr une solution pourrait être de prévoir que la lanière arrière de la sandale soit amovible. L'utilisateur pourrait donc retirer cette lanière lorsqu'il veut faire usage de sa chaussure comme d'une mule, sans maintien de l'arrière du pied. Cependant cette solution présente l'inconvénient qu'il convient que l'utilisateur conserve sur lui la lanière qu'il a retiré de manière à pouvoir la 25 replacer sur la chaussure lorsqu'il veut retrouver l'usage premier avec maintien de l'arrière du pied.

La chaussure de l'invention permet de réaliser cette double forme d'utilisation sans présenter l'inconvénient précédent. Cette chaussure comporte de manière connue une semelle, un élément avant de recouvrement laissant dégagé

lanière arrière dans la première position (figure 1) et dans la seconde position (figure 2),

- et la figure 3 est une vue schématique en plan de dessus de la chaussure illustrée à la figure 1.

5 La présente invention concerne une chaussure qui, au gré de l'utilisateur, peut être utilisée comme une sandale ou comme une mule. Pour cela elle présente une lanière arrière qui est apte à assurer le maintien du talon dans la première forme d'utilisation et qui est escamotable par pivotement dans la seconde forme d'utilisation. Dans l'exemple illustré qui va être décrit, la chaussure 1 est une 10 sandale composée d'une semelle 2, d'un ensemble de lanières avant 3, d'une lanière arrière 4 et de moyens de pivotement 5.

L'ensemble 3 des lanières avant est fixé à la semelle 2 par quatre lignes latérales d'ancrage, respectivement 6a, 6b pour les deux lignes antérieures et 7a et 7b pour les deux lignes postérieures. Entre les deux lignes d'ancrage 15 antérieures 6a, 6b s'étend une première lanière transversale 8 destinée à maintenir l'avant du pied dans la zone antérieure la plus large.

Entre les deux lignes postérieures d'ancrage 7a, 7b s'étend une seconde lanière transversale 9 qui présente, de chaque côté, une portion 9a, partant de la ligne d'ancrage 7, qui est sensiblement perpendiculaire à la semelle 2 puis une 20 portion inclinée vers l'avant 9b, destinée à assurer le maintien du pied au niveau du cou-de-pied.

Une troisième lanière longitudinale 10, relie vers l'extérieur de la chaussure, les deux lanières transversales 8,9.

Dans l'exemple illustré à la figure 3, la première lanière transversale 8 25 est décomposée en deux tronçons distincts 11, 12, de manière à permettre le réglage de l'application de cette première lanière transversale 8 sur le pied en fonction de la taille de celui-ci. Le premier tronçon 11, vers l'intérieur de la chaussure est de petite dimension, étant muni à son extrémité libre d'un anneau 13 oblong. Le second tronçon 12 est de grande dimension de manière à pouvoir

position, après réglage éventuel de la première lanière transversale 8, l'utilisateur assure le maintien du pied en réglant la longueur de la lanière arrière 4 et en bloquant celle-ci en position grâce aux éléments à crochets 15 et à boucles 16. Comme illustré à la figure 1, dans ce cas, les extrémités 4a et 4b de la lanière arrière 4 sont solidaires des anneaux latéraux 14 au niveau des côtés 14b tournés vers l'arrière.

Si au contraire l'utilisateur veut porter la chaussure 1 sous la seconde forme d'utilisation, similaire à celle de la mule, sans maintien du pied à l'arrière, il lui suffit d'effectuer le pivotement de la lanière arrière 4 de sa première position illustrée à la figure 1 à la seconde position illustrée à la figure 2. Ce pivotement se fait en coulissant les deux extrémités 4a et 4b depuis les côtés 14b tournés vers l'arrière jusqu'aux côtés 14c tournés vers l'avant des anneaux 14. La lanière arrière 4 vient alors se superposer à la seconde lanière transversale 9 dans sa partie inclinée 9b. Si besoin est l'utilisateur effectue le réglage de la longueur de la lanière arrière 4 de manière à ce qu'il y ait une superposition exacte entre ces deux lanières 4, 9 et qu'ainsi la lanière arrière 4 dans la position de la figure 2 reste constamment en prise sur la seconde lanière transversale 9 pendant l'usage de la chaussure.

L'anneau 14 aurait bien sûr pu avoir d'autre configuration, notamment circulaire ou ovale. Cependant la forme en triangle est préférée puisqu'elle permet une séparation précise entre les deux positions distinctes et puisque de plus elle permet une répartition homogène des forces de traction exercées par la lanière arrière 4 sur toute la longueur 14b de l'anneau dans le cas où ladite lanière arrière 4 assure le maintien du talon.

L'exemple de réalisation qui vient d'être décrit n'est pas exhaustif de l'invention. En particulier le même effet de pivotement peut être obtenu par d'autres moyens que celui d'un anneau en forme de triangle, par exemple à l'aide de rivets. De plus les moyens de pivotement peuvent également être fixés sur la semelle de part et d'autre de celle-ci avec cependant dans ce cas l'inconvénient

REVENDICATIONS

1. Chaussure comportant une semelle (2), un élément avant de recouvrement laissant dégagé l'arrière du pied et une lanière arrière (4) destinée à venir en appui sur le talon, caractérisé en ce que la lanière arrière (4) est solidaire de moyens (5) latéraux de pivotement, agencés en sorte de permettre le pivotement de ladite lanière (4) entre sa position d'appui sur le talon et une seconde position où elle s'applique sur une zone d'appui de l'élément avant de recouvrement.
- 5 2. Chaussure selon la revendication 1 caractérisée en ce que les moyens de pivotement sont fixés sur l'élément avant de recouvrement.
- 10 3. Chaussure selon la revendication 1 caractérisée en ce que les moyens latéraux de pivotement sont fixés sur la semelle.
4. Chaussure selon l'une des revendications 1 à 3 caractérisée en ce que chaque moyen latéral de pivotement consiste en un anneau (14) ayant la forme d'un triangle isocèle, qui est fixé par sa base horizontale (14a) dans la partie postérieure de l'élément avant de recouvrement, et en ce que les extrémités (4a, 4b) de la lanière arrière (4) sont solidaires de l'anneau (14), pouvant coulisser librement par rapport à celui-ci en sorte que la lanière (4) est assujettie au côté (14b) du triangle tourné vers l'arrière dans la première position et au côté (14c) du triangle tourné vers l'avant dans la seconde position.
- 15 5. Chaussure selon l'une des revendications 1 à 3 caractérisée en ce que les moyens de pivotement sont constitués de rivets.
6. Chaussure selon l'une des revendications 1 à 5 caractérisée en ce que, l'élément avant de recouvrement est composé d'un ensemble (3) de lanières, parmi lesquelles une lanière transversale (9) postérieure s'étendant entre deux lignes d'ancre (7a, 7b) avec, de chaque côté, une portion (9a) partant de la ligne d'ancre et sensiblement perpendiculaire à la semelle (2), prolongée par une portion inclinée vers l'avant (9b), destinée à assurer le maintien au niveau du cou-de-pied, et faisant office de zone d'appui de l'élément avant de recouvrement.
- 20
- 25

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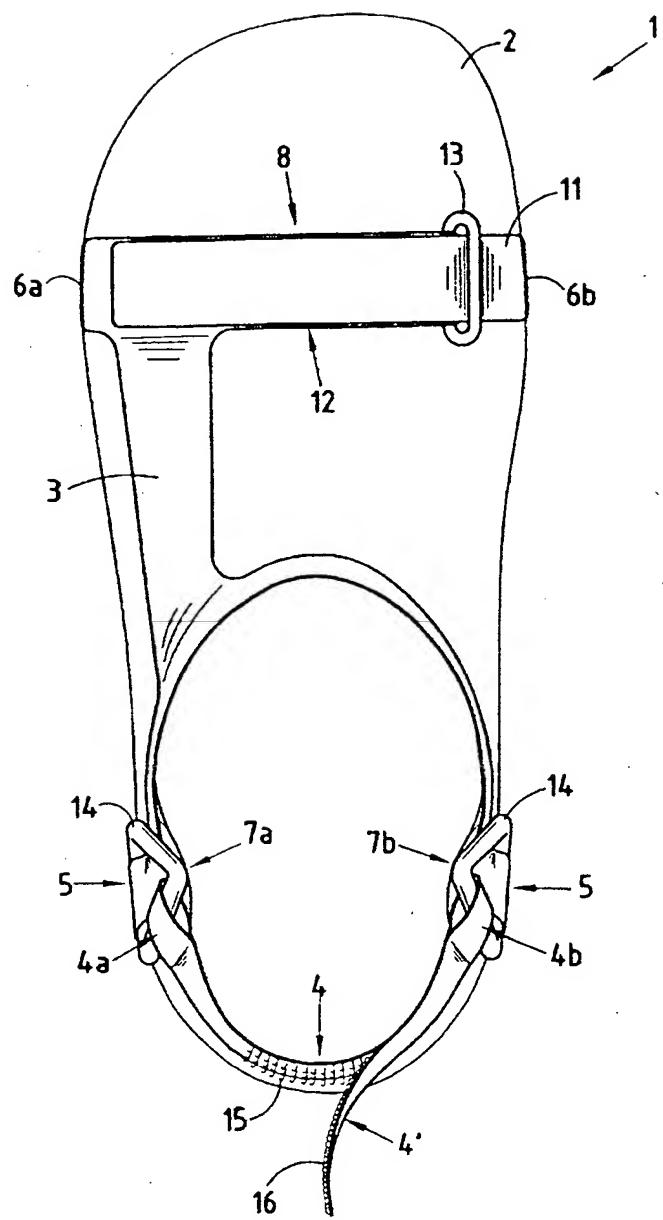


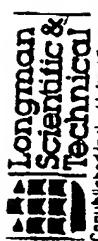
FIG.3

Injection Mould Design

A textbook for the novice and a design manual for the thermoplastics industry

R. G. W. Pye

Fourth Edition



Co-published in the United States with

John Wiley & Sons, Inc., New York

In association with
The Plastics and Rubber Institute

SIDE CORES AND SIDE CAVITIES

9.1.1 Mouldings embodying side holes, recesses or slots

In general, any component which has a local recess, hole or slot which is not in-line-of-draw will necessitate the incorporation of a side core in the mould design.

There are, however, a few exceptions to this generalisation, and we will discuss these first. For example, a hole in the side face of a component could be moulded in line of draw by astute component design. In example (a) (Figure 9.4) the hole is formed by a part of the core abutting on to the sloping face of the cavity. To achieve this condition the component must be designed with a definite step as shown. This step is normally equal to the general wall section. The resulting aperture in the moulding is illustrated in the lower drawing.

When a step is not permissible an alternative design may be adopted (Figure 9.4b). In this the side wall of the component is caused to slope at an obtuse angle with respect to the base. This permits the hole to be formed by a projection from the core which abuts on to the cavity as shown. Note that the top face of the projection (at X) must be such that it does not create an undercut. The resulting aperture formed in the moulding is illustrated in the lower drawing.

Moulded holes of this type, while they make the mould design more simple, are often unacceptable to the component designer as they inhibit his style. It is, however, used quite extensively for the cheaper lines of manufacture where mould costs have to be kept to a minimum.

A hole can also be incorporated into the side face of the moulding by a subsequent machining operation. This method should always be considered by the mould designer before proceeding with a side core design as it has the following advantages:

(i) The mould is simple and therefore relatively cheap.

(ii) Ease of operation of the mould creates less likelihood of production difficulties.

GENERAL

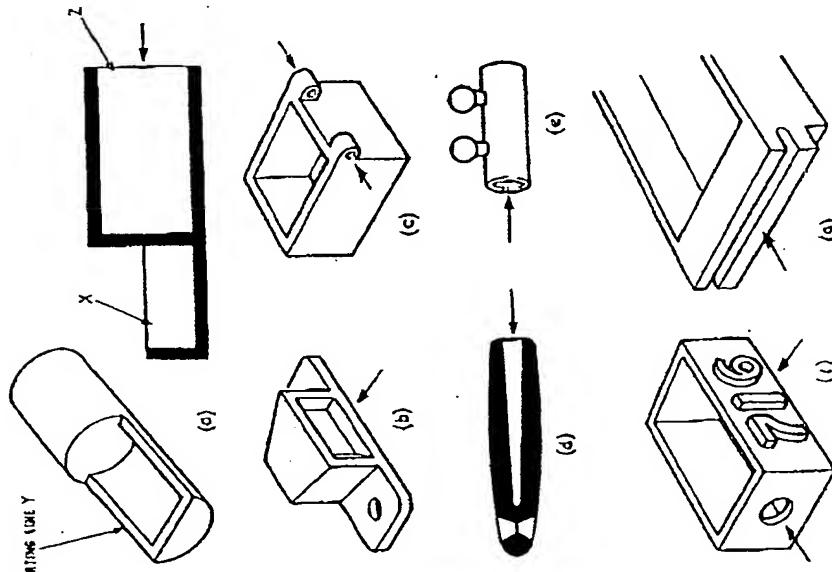
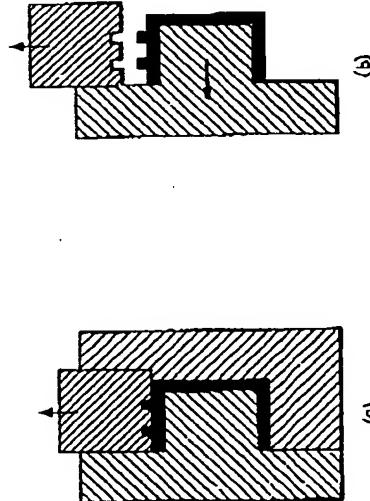


Figure 9.3—Examples of components which necessitate either side core or side cavity

(iii) Whereas a side core breaks up the normal flow of material entering the impression and there is a probability of flow lines developing with this method it is impossible for this to happen. Regardless of flow lines and mould cost, however, economics will usually dictate that the hole must be moulded in by means of a side core, rather than incorporating it as a separate operation, at extra cost. The general form of the component may make the use of the split design more appropriate than the side core design. Note, however, that if the component necessitates a slender core (discussed later in this chapter) the side core design can be used with advantage.

Figure 9.2—Principle of side cavity: (a) moulding position; (b) withdrawn position



GENERAL

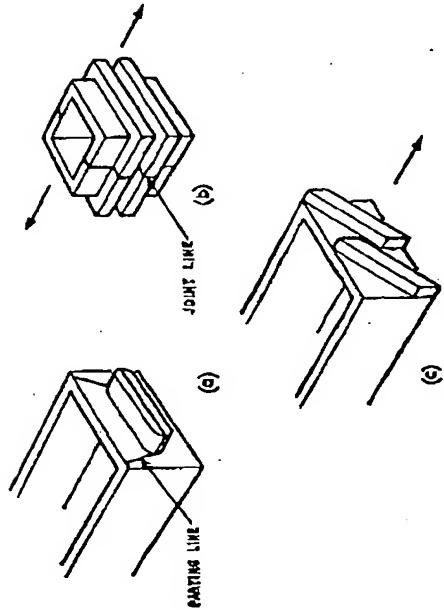


Figure 9.7—Moulding which incorporates projections: (a) moulded with stepped parting line; (b) moulded with split; (c) moulded with side cavity

projection is located from the top surface the more pronounced will be this mark (see also Figure 5.10).

The parting surface cannot be stepped to accommodate two projections, one above the other, as for example in Figure 9.7b. This component would be formed in splits which, as we have already shown in Chapter 8, may be used for components that incorporate projections below the general parting line. Generally speaking, splits are used where the projections are continuous on the periphery (Figure 9.7b), or where the projections occur on diametrically opposite sides.

The side cavity design is used for components which incorporate projections on one or more sides and which cannot be more simply moulded by either of the previous methods. Consider, for example, Figure 9.7c, where two projections occur, one overlapping the other. The stepped parting line design cannot be used because of the overlap, and as the projections occur on one face only it would not be desirable to use the splits design either.

A further example, a box, is shown in Figure 9.3f. This incorporates figures which project from one of the side faces. For similar reasons to those above, the side cavity design would be chosen. Figure 9.3g shows a part of a sliding tray. A runner groove is incorporated at both ends. Two side cavities would be used for this component, each being operated independently. Similarly, if a component has projections on two adjacent sides, the side cavities would be arranged on a plane at right angles to one another.

Finally let us consider the type of component which has projections and undercutts on all four sides, as for example the toy tank (Figure 9.8). A

SIDE CORES AND SIDE CAVITIES

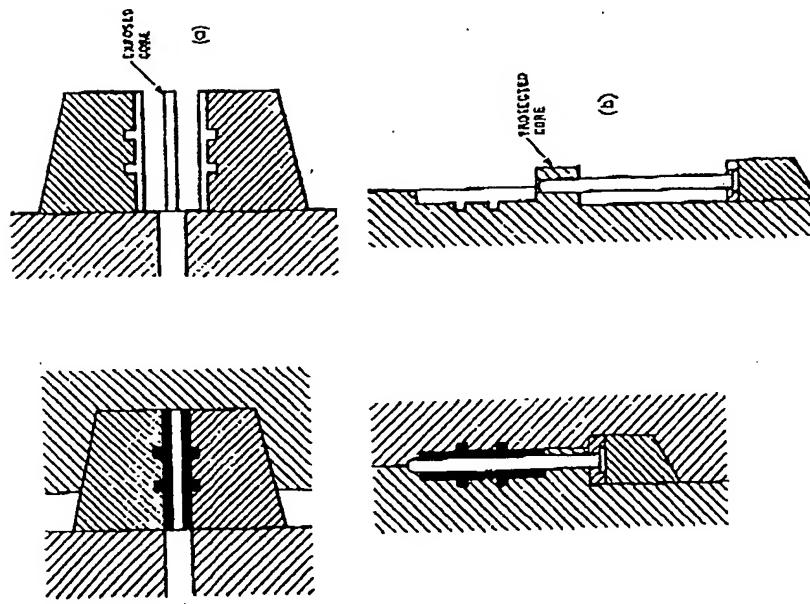


Figure 9.8—For particular components side core design is preferable to splits design

These are: (i) a stepped parting surface, (ii) splits, and (iii) a side cavity. Which of these he chooses will depend very much on the number of projections and their position and shape.

The component shown in Figure 9.7a can be moulded quite simply by the first of these methods. The mould's parting surface is stepped locally so that it passes through the centre of the projection. (Note the thick line on the end of the component.) The projection does not, therefore, create an undercut in the mould and can be ejected in-line-of-draw. As there are no moving parts within the mould, the mould design, manufacture, and subsequent operation are more simple than for the other methods. There is a disadvantage, however, in that the mark left by the mould's parting surface is apparent on the finished moulding, and the deeper the

SIDE CORES AND SIDE CAVITIES

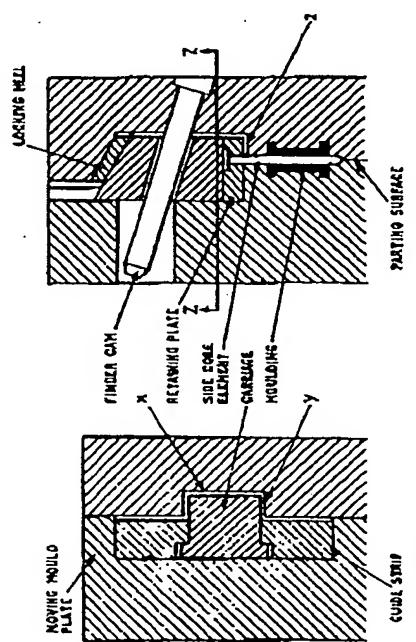


Figure 9.10 - Internal side core assembly. Longitudinal and transverse cross-section through part of mould

plate to the carriage. (If the design had necessitated a side cavity element this would have been secured directly to the carriage.) The actuation of the carriage is by means of a finger cam although, as for splits, other forms of actuation are often used. The carriage is locked in the forward position by a locking heel.

The operation of the mould is as follows:

When the mould is opened, the finger cam causes the carriage assembly to move away from the impression and the side core element to be withdrawn from the moulding. As the cam is not in permanent contact with the carriage, provision should be made to ensure that the carriage remains in the withdrawn position when the mould is open. The spring detent method (discussed in Chapter 8) may be used for this purpose (Figure 8.29). When the mould closes, the cam re-enters the angled hole in the carriage and the assembly is progressively returned to the moulding position. The final movement and lock is attained by the locking heel. A mould of this type is shown in Plate 9.

INTERNAL SIDE CORE (ON SIDE CAVITY) ASSEMBLY DETAILS. As previously stated, the assembly consists of a carriage and either a side core element or a side cavity element. These elements may be secured to the carriage either directly or by means of a retaining plate. The carriage has the same T-shape form as the sliding split and the various methods of build-up shown in Figure 8.5 apply here also. However, in practice, the carriage is normally relatively shallow and the one-piece design (8.5a) is usually preferred. The carriage, unlike the split, rarely carries the moulding form so it may be made from a low-carbon steel, suitably heat-treated, to give a wear-resisting surface.

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CARRIAGE FITTING. The nature of the side core assembly (or side cavity assembly) does not normally permit the carriage to be mounted on top of the moving mould plate, and room for the carriage is provided by a pocket machined in both mould plates. To illustrate the construction a sketch of the side core assembly, mounted in the moving mould plate, is shown in Figure 9.11. The major part of the carriage is accommodated below the parting surface in a pocket (Y). The width of this pocket is sufficient to accommodate the guide strips, which are secured by screws (not shown). The portion of the carriage which projects above the parting surface must be accommodated in a pocket in the fixed mould plate (Figure 9.10, right view). One face of this pocket is angled to form the locking heel.

The remainder of the pocket in the fixed mould plate is dimensioned so that there is a definite clearance all around the top section of the carriage-X, Y, Z.

GUIDING ARRANGEMENT. The guiding arrangement for the internal side core (or side cavity) assembly is similar to that adopted for guiding splits (Section 8.2.1). The assembly is a relatively small unit, however, which allows a local guiding arrangement to be used. This contrasts with the splits design where the guides normally extend completely across the

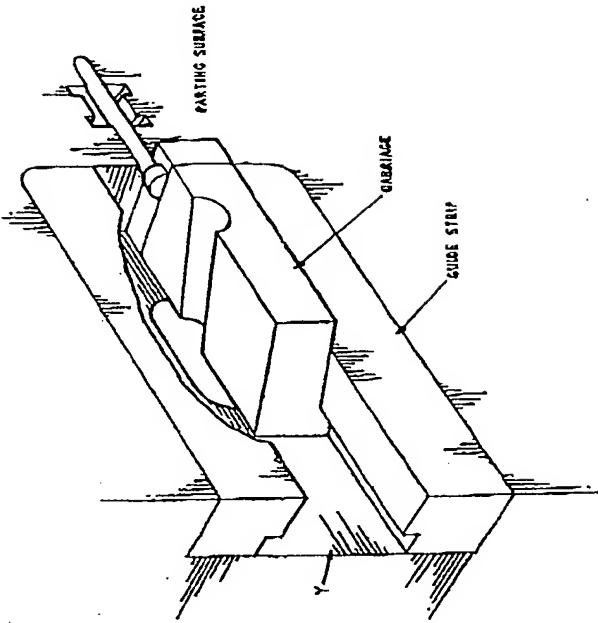


Figure 9.11 - Side core carriage fitting details

SIDE CORES AND SIDE CAVITIES

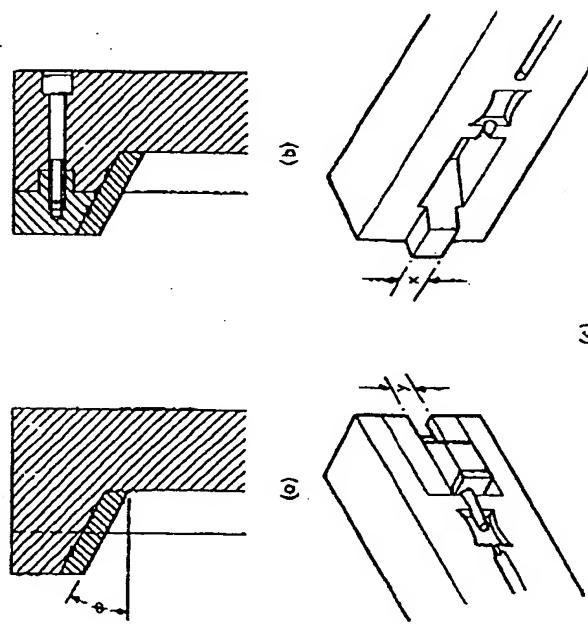


Figure 9.14 - Locking heel

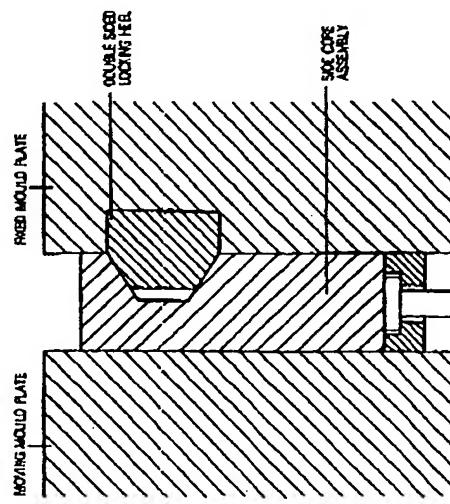


Figure 9.15 - Double-sided locking heel

DESIGN FEATURES

is to fabricate the heel by securing a heel block on to the mould plate as shown (b). A projection is provided on the underside of this heel to withstand the applied forces.

Accommodation must be provided in the moving mould plate for that part of the locking heel which projects above the parting surface. In practice, the heel is accommodated in the space provided for the carriage movement in the moving mould plate (c). The width of the heel (x) must therefore be less than the distance between the guide strips (y).

An alternative design for the locking heel is shown in Figure 9.15. The functional member of this case is basically trapezoidal in cross-section and is secured to the fixed mould plate as indicated. This 'double sided locking heel' engages with a complementary shaped recess machined across the side core assembly.

The object of this design is to ensure that the side core assembly is locked in position, in two directions, when the mould is shut. A typical example of the use of this design is illustrated in Plate 9.

9.2.2 External side core (or side cavity) assembly.

In this design the side core (or side cavity) is coupled to an externally mounted carriage. This carriage, often supported by an outrigger arrangement, is generally actuated by hydraulic or pneumatic means, although cam and spring actuation are occasionally used.

Figure 9.16 shows a typical mould which illustrates the main features of this design. The mould is for a box-shaped component having two holes in one side. To form these holes, twin cores project through the side walls of the cavity. The side cores are attached to the carriage by a retaining plate. The carriage is supported on two columns which, together with the platform, are termed the outrigger. The ram of a

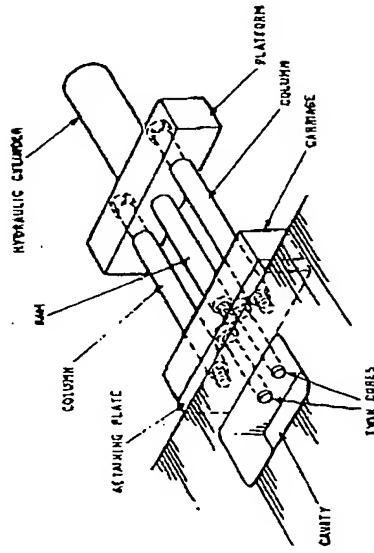


Figure 9.16 - External side core assembly. (Note—In this drawing columns are shown larger than required, for reasons of clarity. In practice, the length of these columns depends on side core movement required.)

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SIDE CORES AND SIDE CAVITIES

supporting the carriage. This is of particular importance when cam and spring methods of actuation are used.

Several designs for this unit are shown in Figure 9.19. The system shown at (a) is used in conjunction with a light actuator. Two columns project from the mould wall and a platform is mounted on them as shown. As the ram of a light actuator is relatively slender it is usually desirable to support the weight of the carriage, which is indicated by the chain-dotted line, on the columns. (An isometric sketch of a complete assembly including the actuating cylinder is shown in Figure 9.16.) For heavier cylinders, a four-column design may be adopted (b). With this system the proportions of the actuating ram are usually sufficient to support the carriage. However, if extra support is thought to be desirable, the latter items should be given a case-hardened surface if they are to act as guides for the carriage.

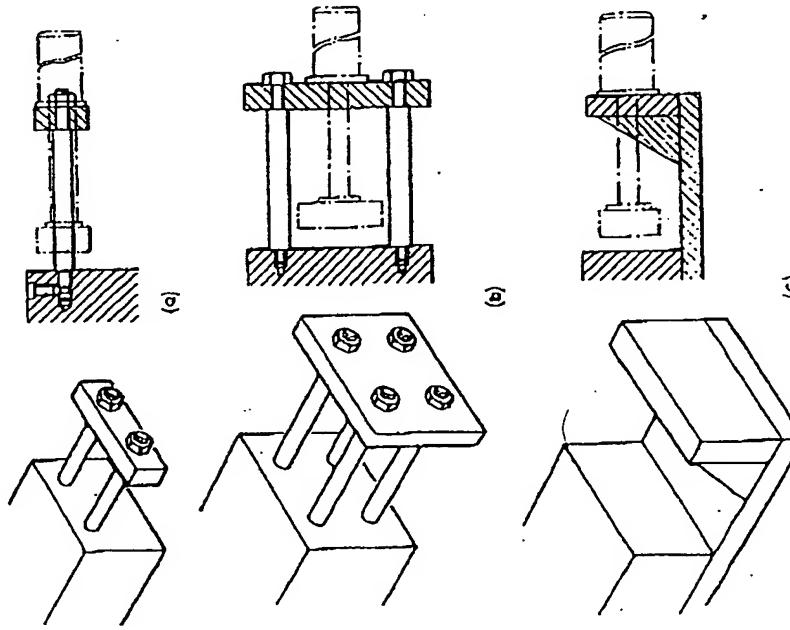


Figure 9.19—Outriggers for side core and side cavity designs

half-shoes may be fitted which slide on the columns. The relative position of the carriage and the actuator in this example is shown by the chain-dotted line in the sectional drawing.

Plate 10 shows a two-impression mould which incorporates an outrigger of the four-column design. In this example side cores are incorporated on two opposite sides of the mould.

An alternative design is shown at Figure 9.19c. This design does not incorporate columns but is of a fabricated, welded steel construction with the two triangular members giving the required rigidity to the platform.

The platform in all designs may be subjected to a considerable force and the designer should ensure that the thickness of this platform is sufficient to withstand this force without undue deflection.

A mild steel is suitable for both the platform and the columns, although the latter items should be given a case-hardened surface if they are to act as guides for the carriage.

METHODS OF ACTUATION

The actuator. The most common method of operating the external carriage is by means of an actuator. The ram of the actuator may be either directly coupled to the carriage or indirectly coupled via a toggle linkage system. In the first case, the actuator is mounted on an outrigger platform and the ram coupled to the carriage either by a screw or by a flange connection. A typical arrangement (Figure 9.20) illustrates a side core mounted on the parting surface of a mould. The side core is shown in the forward position (a) and in the withdrawn position (b). To prevent undesirable bending forces the actuator should be mounted in line with the core so that it can apply a direct pull (or push) to the side element. The actuator may be operated either by hydraulic or pneumatic means.

The hydraulic supply is obtained either by coupling the side core actuator to the injection machine's hydraulic circuit or by coupling to an independent portable pumping unit. In either case, pressures of between 7×10^6 and $14 \times 10^6 \text{ N/m}^2$ (1×10^3 and $2 \times 10^3 \text{ lbf/in}^2$) are usually available.

The pneumatic supply, on the other hand, is normally tapped from the factory air line system, the pressure of which is seldom more than $7 \times 10^5 \text{ N/m}^2$ (100 lbf/in^2).

To apply a corresponding locking force, the size of a pneumatic actuator must be many times larger than that of a hydraulic one. It follows, therefore, that the pneumatic method is usually limited to cases where other methods of actuation include:

- (i) The carriage can be operated at any suitable time (e.g. side core or side cavities can be withdrawn before the mould is opened).
- (ii) Long side core withdrawal strokes can be achieved very easily.
- (iii) Design and mould making are simplified.

SIDE CORES AND SIDE CAVITIES

DESIGN FEATURES

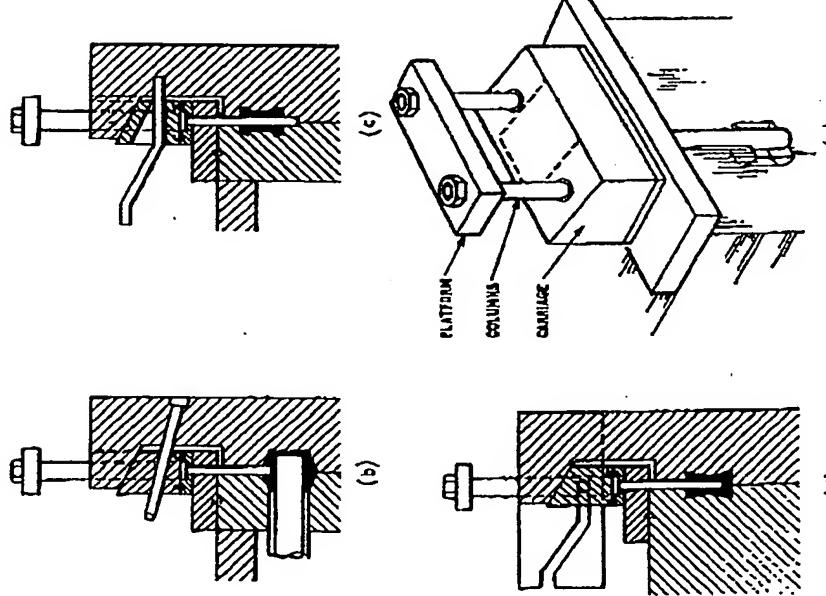


Figure 9.22—Various cam methods of actuating external carriage

takes place as the mould is being closed. The carriage is locked by the locking heel coming into contact with its angled face. The dotted lines indicate the position of the locking heel.

With systems using finger cams (Figure 9.22b) or dog-leg cams (c), a suitable hole is provided in the carriage to accommodate the cam, whereas for the cam plate system (d) a stud is provided on either side of the carriage to fit into the cam plate. Details of the cams, materials, and formula for movement are given in Section 8.2.2.

Spring actuation. If it is required to move the side core only a short distance then spring actuation may be considered. Figure 9.23 shows a

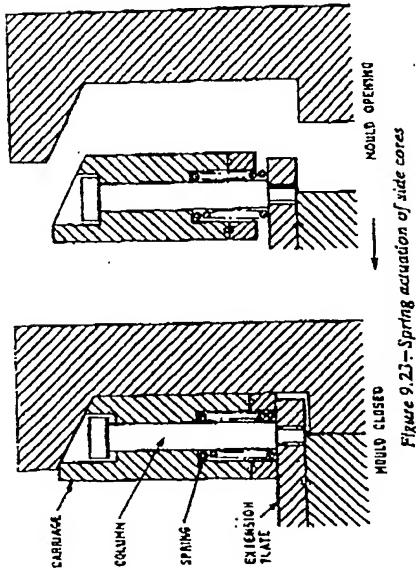


Figure 9.23—Spring actuation of side cores

part-section through the relevant details of this system. The carriage is mounted on columns screwed to the extension plate. Suitable recesses in both the carriage and the retaining plate accommodate a spring mounted on each column. When the mould is being opened the springs exert a force on the carriage which progressively withdraws the side element to which it is attached (not shown). The shouldered heads on the columns limit the outward movement of the carriage. As the mould closes the locking heel contacts the sloping face of the carriage which progressively returns the side element to the moulding position.

Mechanical sliding device. A side core actuating mechanism is available as a standard part from Hasco®. This device is illustrated, in simplified form, in Figure 9.24. It consists primarily of two circular cross-section racks which incorporate angular teeth and these racks are mounted at right angles to each other to enable the teeth to mesh. The assembly is normally mounted on an external mould wall. To illustrate the meshing arrangement of the two racks, one is shown with its teeth facing the reader and the teeth depressions are shown black. The second rack, where the teeth are below the visible surface, these teeth are shown dotted and the teeth depressions indicated by shading.

The side core operating rack (1) is attached to the sloping face of the side core element (shown chain dotted), while the primary operating rack (2) is securely attached to the fixed mounting block (3). This block in turn is attached to the fixed mould plate bolster via a packing block (4). To ensure that the teeth remain permanently in engagement, the two racks are mounted within a guide block (5), which is shown chain dotted for reasons of drawing convenience (note that this is not a true cross-section). The guide block is attached to the moving mould plate via a second packing block (6). A suitable recess must be provided in the heel block (at 'V') to accommodate the moving side core operating rack.

SIDE CORES AND SIDE CAVITIES

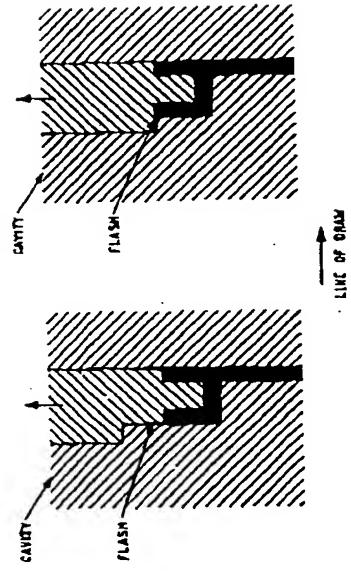


Figure 9.25—Fitting of side elements should be such that if flash occurs, it is in line of draw: (a) undesirable design; (b) preferred design

TYPES OF SIDE CORE AND SIDE CAVITY

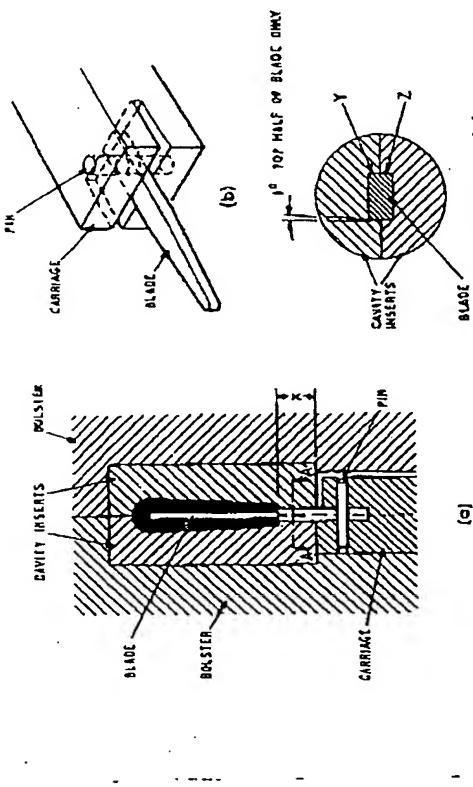


Figure 9.26—Semi-location of side core element

condition as it permits the carriage assembly to be mounted on either mould half, whichever is the more convenient. The two basic designs to be considered are (i) where the side core element is semi-located, and (ii) where the side core element is positively located.

SEMI-LOCATION. This method is where the side core element is permanently located in a slot in one mould half. An example where this method has been used is shown Figure 9.26.

The component, a knife handle, incorporates a centrally placed hole for the knife tang. The female form of the handle is formed by a pair of cavity inserts mounted in suitable bolsters. The side core element which forms the hole is a rectangular section blade fitted into a slot in the carriage and secured by a pin. That part of the blade which is outside the moulding form (X) is housed an equal depth in both mould inserts. The cross-sectional shape of the blade and of the corresponding slots in the cavity inserts are shown enlarged at (c). A 1° angle should be incorporated on each side of the top half of the blade (Y) to avoid excessive wear occurring. A similar angle is not required on the bottom of the blade (Z) as this portion is in permanent contact with the cavity insert.

POSITIVELY LOCATED SIDE CORE. It is often desirable to give a more positive location to the side core than that given in the previous example. This is particularly so when the design necessitates very slender round cores. With the previous design there is the possibility that a very slender core may be accidentally moved out of its locating recess, with the likelihood of the mould being damaged. To obviate this possibility the side core can be positively located in a block adjacent to the insert. An example of a positively located side core design is shown in Figure 9.27a. The side core is positively located by the location block secured

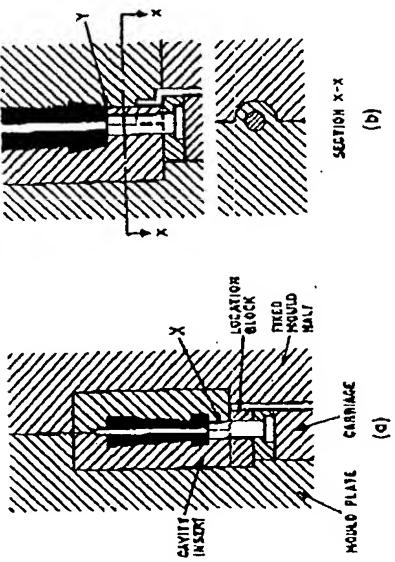


Figure 9.27—Positively located side cores

to the cavity insert; both are mounted in the mould plate. To allow the side core to pass through the location block, the block must protrude beyond the parting surface of the mould and therefore a suitable pocket is provided in the other mould half as shown. Note, however, that the

SIDE CORES AND SIDE CAVITIES

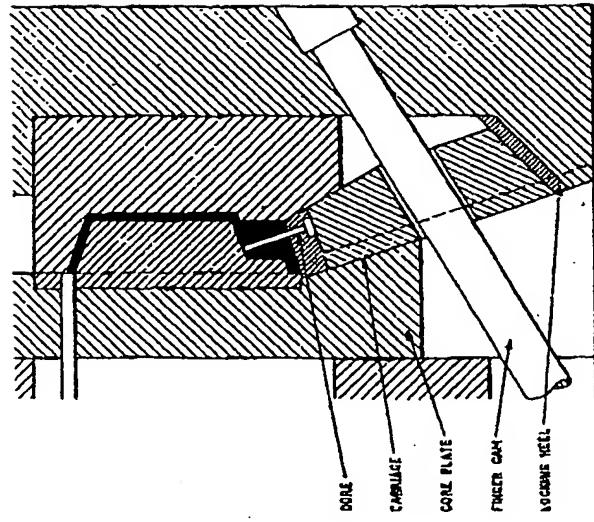


Figure 9.13-Angled withdrawable side core

bucket machined into the bolster. The carriage is retained and guided by curved guide strips. The centre line chosen for the system must be the same as the centre-line radius of the component, to allow the side core to be withdrawn. Apart from the radius, the basic assembly is the same as that for a side core mounted on the mould's parting surface. None of the previously discussed direct actuation methods are suitable for this design, due to the curved operating path.

One method of actuation is the hydraulically actuated rack and pinion shown in the figure. The ram of the hydraulic cylinder is attached to a rack, the latter being a free-running fit in a bored hole in the bolster below the parting surface. Movement of the rack actuates a pinion attached to the actuating arm. A slot in the actuating arm accommodates a stud secured to the carriage. Movement of the actuator ram thereby operates the side core on a curved path.

9.3.5 Side cavities

When a projection or recess occurs on the side face of a component, preventing it from being moulded in-line-or-draw, it is necessary to design the cavity so that a part of it is movable to allow this restriction to be relieved. That part of the cavity which is movable is termed the *side cavity*. The basic principle of this design is shown in Figure 9.2 which

TYPES OF SIDE CORE AND SIDE CAVITY

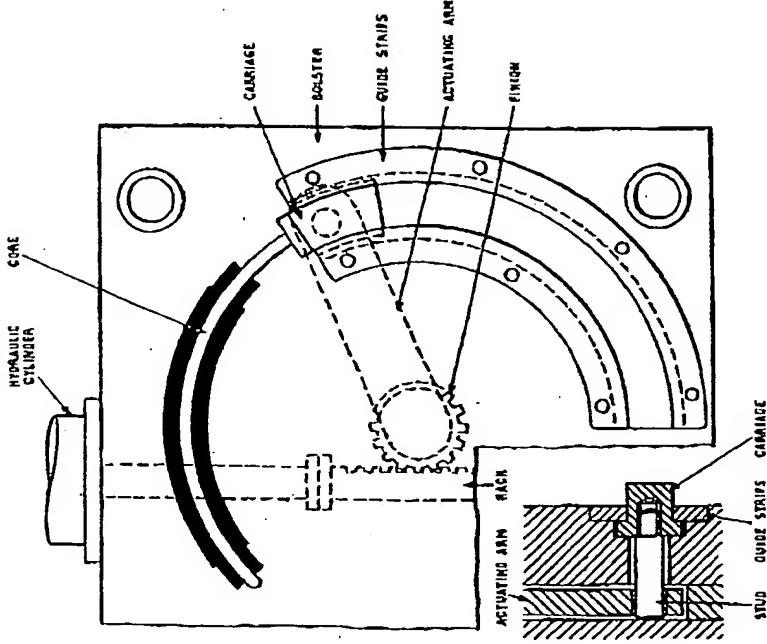


Figure 9.14-Curved side core

shows the side cavity in the moulding position and the withdrawn position, respectively.

The side cavity design can be treated in a similar manner to that of the side core, and in fact with certain designs the two terms are synonymous.

SIDE CAVITIES MOUNTED ON THE CAVITY SIDE. When it is required to mount a side cavity on the cavity side, the identical design to that described for a side core, mounted on the cavity side, is used. Figure 9.35 shows an example to illustrate the similarity. The component in this case is a box moulding which incorporates a projection on one of the side walls (a).

The projection is formed by a recess machined into a circular side cavity block which extends through the cavity wall. A circular cavity block is preferred as it is simple to make and fit. Circumstances, however, often dictate that square or rectangular side cavity blocks must be incorporated.

SIDE CORES AND SIDE CAVITIES

assembly when the mould is closed. A finger cam is shown as the actuating method. (A comparison is made between this design and the side core design (illustrated in Figure 9.30) it will be seen that the two designs are similar, and the same general comments are therefore applicable to both.

This design is generally preferred to the previous design in that a positive lock is applied by the locking heel to the side cavity assembly when the mould is closed. (In the previous design the lock is achieved hydraulically.)

MULTIPLE-SIDE CAVITIES. Certain components, because of their form, will necessitate the use of more than one side cavity. Consider for example the toy tank shown in Figure 9.8. This component has numerous projections and undercuts on all four sides. (Note that the barrel is a separate component.) The turret and top of the tank, being in-line-of-draw, are incorporated in a solid cavity as shown (Figure 9.9).

A section taken transversely through the mould (Figure 9.9a) illustrates how the sides of the tank are formed, while the longitudinal section (Figure 9.9b) shows the side cavity which forms the front of the component. (A similar side cavity is required for the rear.) Note that in all cases the forward movement of the side cavity is positively stopped by the side cavity block coming up against the core insert.

9.4 STANDARD MOULD PARTS

9.4.1 Standard mould systems

In general a standard mould system may be used for mould designs which incorporate side cores, the only modification being that heel blocks have to be incorporated for the internal side core designs.

9.4.2 Positive locking actuator

As mentioned, the disadvantage of operating an external side core or side cavity assembly by hydraulic or pneumatic means is that a relatively large locking force is required in order to maintain the position of the side core (side cavity) element during the injection phase (Section 9.2.2). 'Husco'® minimises this problem by adopting a design in which the piston rod is interlocked in the forward operating position, during the injection phase. Thus a relatively small diameter positive locking actuator may be used.

A simplified illustration of this standard mould component is shown in Figure 9.38. The assembly consists of a piston/piston rod (1), which operates within a cylinder (2). The interlock mechanism comprises a set of segments (3) which, when functioning as an interlock, and forced into a circular tapered groove machined in the piston rod (at Y). These segments are operated by a spring-loaded locking sleeve (4). One method of attaching the actuator to the mould (chain dotted) is via a flange (5) as shown.

STANDARD MOULD PARTS

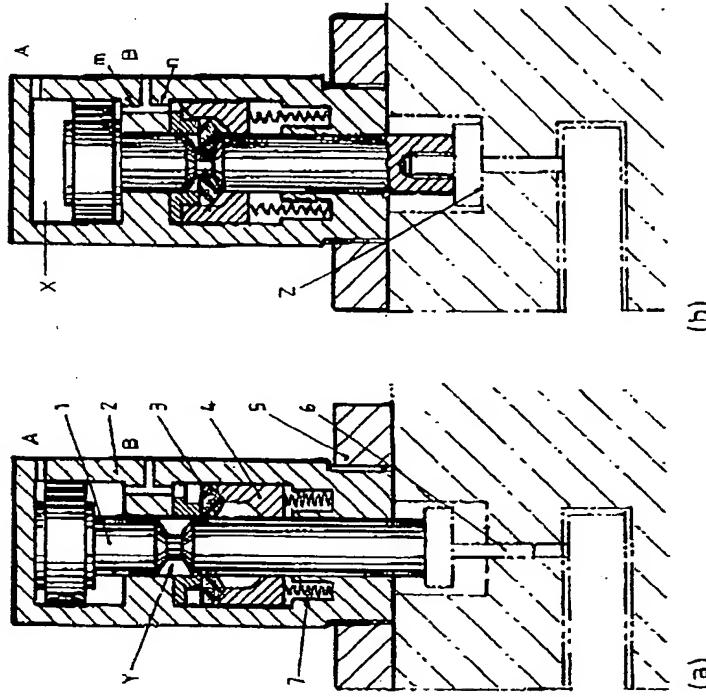


Figure 9.38-Husco positive locking actuator: (a) side core in withdrawn position; (b) side core in forward position (simplified illustration)

The illustration at 'a' shows the positive locking actuator in the non-operative position, that is with the side-core element (6) fully withdrawn, while the second drawing at 'b' illustrates the unit in the operative position, with the side core element in the moulding position.

The operation is as follows: hydraulic fluid is caused to enter port 'A' via a suitable control valve (not shown), this actuates the piston and, in so doing, discharges hydraulic fluid from port 'B'. Downward movement of the piston continues until the segments are aligned with the tapered groove. This allows the locking sleeve to move upwards (as drawn) by the force applied by a number of springs (7). This causes the segments to enter the groove. Subsequently the locking sleeve passes over the outer face of these segments, thereby holding them securely in that position. The piston rod is thereby interlocked in that position (Figure 9.38b).

The force applied by the melt to the side core element is transferred from the piston rod directly to the body of the actuator via the segments.

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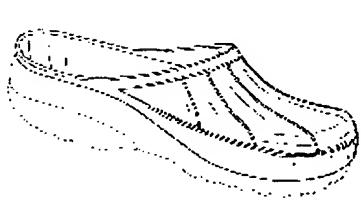
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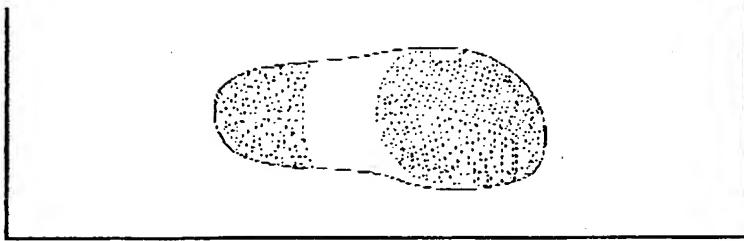
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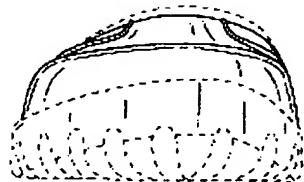
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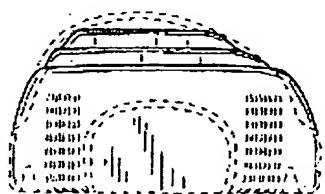
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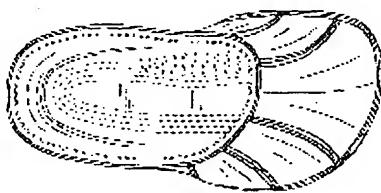
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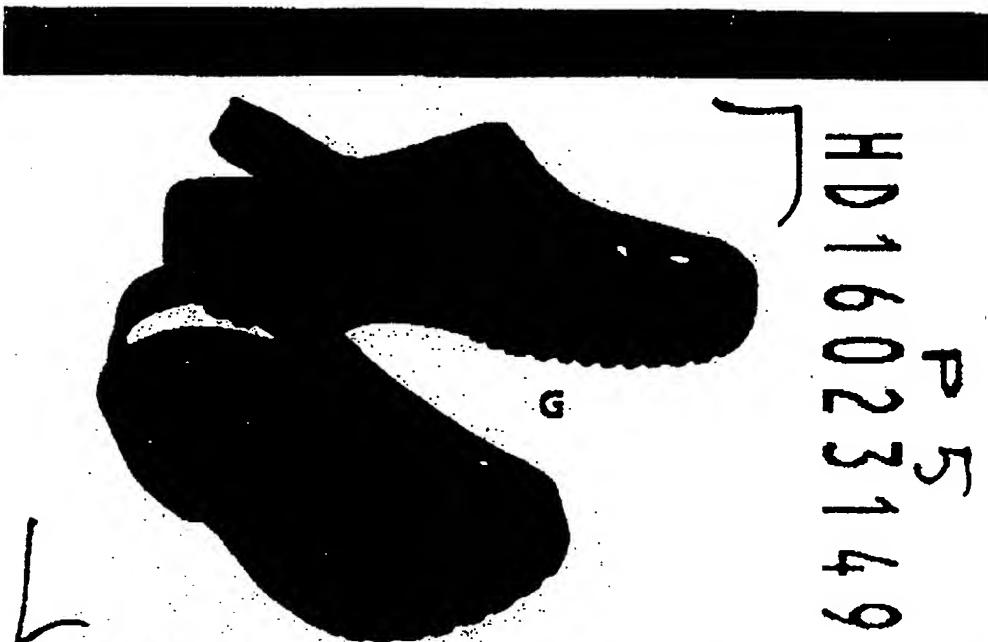
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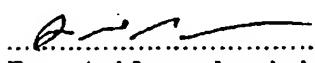
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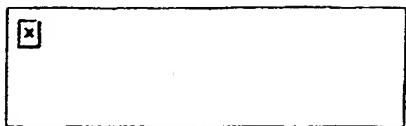
Each of these web pages were published in 2002, before the earliest relevant priority date of the above application, ie 23 May 2003. Still further, each of these documents were published more than 12 months before the effective filing date in Australia of 14 May 2004.

Each of the above documents illustrate a work shoe having all of the essential features of a shoe as described and claimed in the above patent application.


Executed for and on behalf of Craig Taplin
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Enc: Items 1 to 8



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**Supportive
arch base**

Non-marking
& does not
pick up debris

Heel Strap
keeps shoe on foot

Strap can be
rolled forward
for a slip-on
clog shoe

Ventilated toe
for cooling

**Air, Sand
and Water**
filter thru st.



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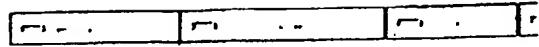
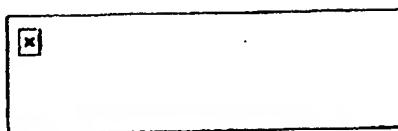
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Explosion

Circulation Nubs
stimulate circulation
& blood flow

Tarsal Bar
spreads ball of foot
& positions toes
for comfort

Arch Support
is built in

Orthotic Heel Cup
supports and
protects heel

Slip-resistant

**Supportive
arch base**

Non-marking
& does not
pick up debris

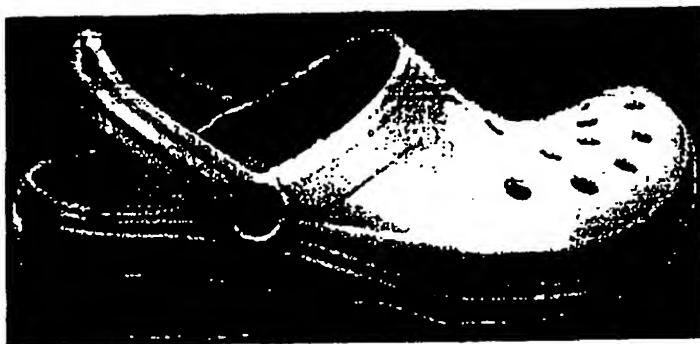
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